OLUME 61 APR -4 1949 FEBRUARY, 1949 NUMBER 2

©C1B 184784

[FOUNDED IN 1906 AS THE AMERICAN QUARTERLY OF ROENTGENOLOGY

The AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

OFFICIAL ORGAN
THE AMERICAN ROENTGEN RAY SOCIETY
THE AMERICAN RADIUM SOCIETY

THE LIBRARY OF CONGRESS
PERIODICALS DIVISION
APR 8 1949
RECEIVED

Editor: MERRILL C. SOSMAN, M.D.
Associate Editor: LAWRENCE REYNOLDS, M.D.
Assistant Editor: RUTH BIGELOW, B.S.
Department Editors: ROBERT B. TAFT, M.D.
GEORGE M. WYATT, M.D.

Editorial Board
A. C. CHRISTIE, M.D. E. H. SKINNER, M.D. LAURISTON S. TAYLOR

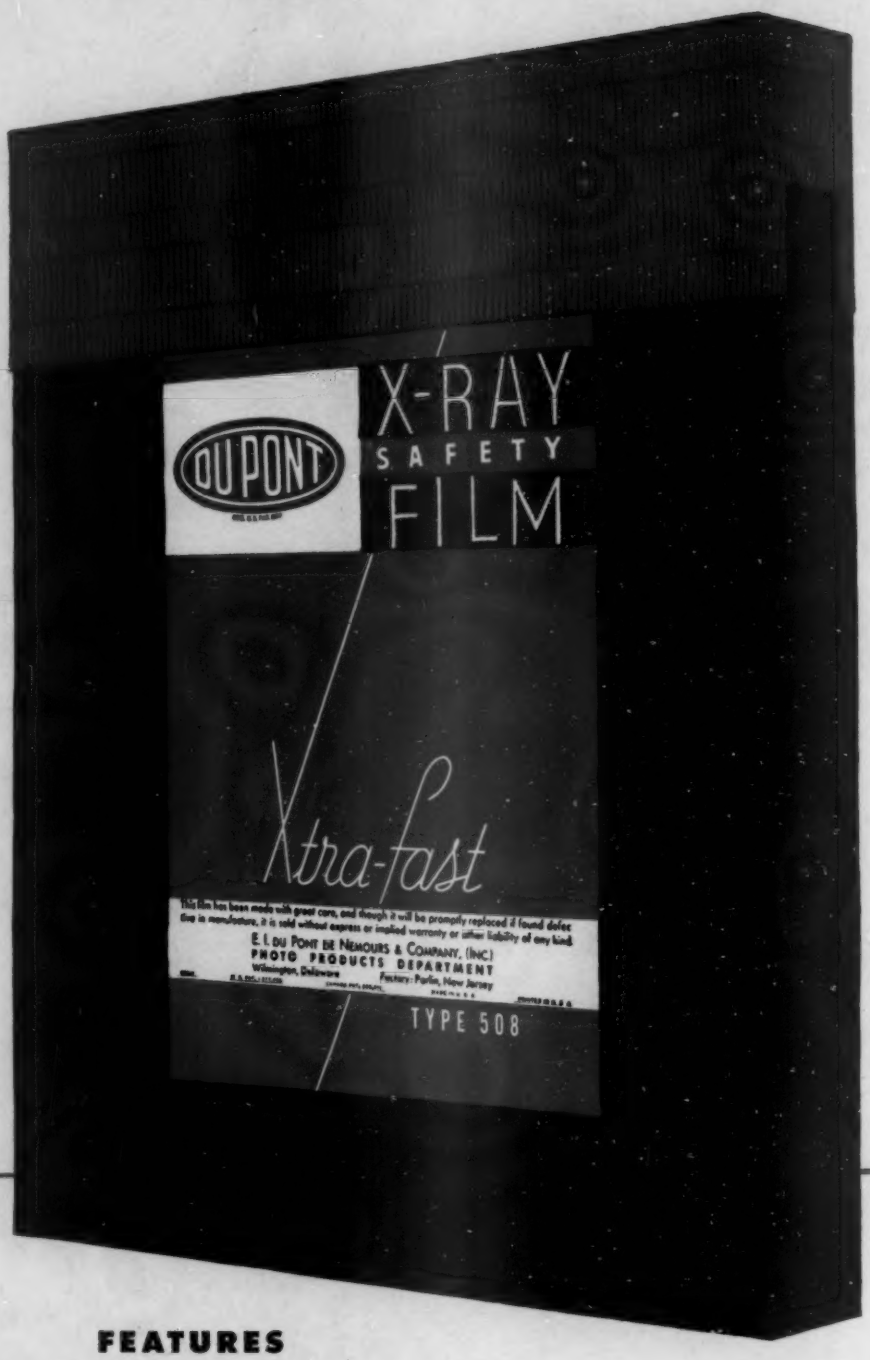
Advisory Board for Pathology
EUGENE L. OPIE, M.D.

ISSUED MONTHLY FOR THE AMERICAN ROENTGEN RAY SOCIETY
BY CHARLES C THOMAS, PUBLISHER, SPRINGFIELD, ILLINOIS

American Roentgen Ray Society *Fiftieth Annual Meeting*
Netherland Plaza, Cincinnati, Ohio, October 4-7, 1949

American Radium Society *Thirty-first Annual Meeting*
Ambassador Hotel, Atlantic City, New Jersey, June 5-7, 1949

EARLY SUBSCRIPTION, $10.00 SINGLE NUMBER, $1.50


DUPONT
X-RAY
SAFETY
FILM
Xtra-fast
This film has been made with great care, and though it will be promptly replaced if found defec
tive in manufacture, it is sold without express or implied warranty or other liability of any kind.
E. I. DU PONT DE NEMOURS & COMPANY, (INC.)
PHOTO PRODUCTS DEPARTMENT
Wilmington, Delaware
Factory: Parlin, New Jersey
TYPE 508

FEATURES

- Clear blue safety base
- Contrast
- Wide latitude
- Convenient packaging
- Speed
- Detail

E. I. du Pont de Nemours & Co. (Inc.)
Photo Products Department
Wilmington 98, Delaware
In Canada: Canadian Industries, Ltd.

DU PONT X-RAY FILM and CHEMICALS

DUPONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

The IOMETER II

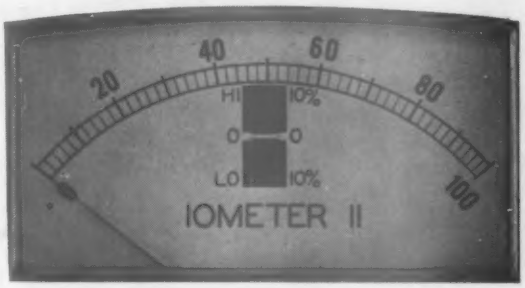
The Victoreen Iometer II is used as a constancy meter which when set to a desired x-ray beam intensity will indicate the percentage deviation from the predetermined setting. An ionization chamber is mounted permanently in the master cone or x-ray tube housing.

The Iometer II is furnished in a case equally adaptable for mounting on a vertical control panel or on a desk. It is inherently stable. The chamber may be placed sufficiently below the filters to eliminate the possibility of temperature error or secondary radiation from the filters.

The Iometer follows closely the values of the beam as read by an r-meter and the same laws of temperature and pressure apply. The absorption of the ionization chamber is very low so that the Iometer may be used on superficial as well as deep therapy equipment.

The new Iometer II incorporates the best features of a null type system. It requires no matching of tubes—the tubes are not used as part of the calibrated circuit—it covers a wide range of intensity values with equal accuracy and with an r-meter assures protection and almost perfect dose control.

For practicability and convenience two scales are incorporated on one meter face. One scale arbitrarily calibrated from 0-100 provides the pre-treatment setting, the other 10-0-10 indicates the percentage change in beam intensity during treatment. The meter is illustrated below.



Consult your equipment manufacturer

5806 HOUGH AVE. **Victoreen** CLEVELAND 3, OHIO

NOW YOU CAN MICROFILM X-RAYS

DENSITIES ABSOLUTELY CONTROLLED WITH THE MICRO X-RAY RECORDER

Records radiographs on a 100 foot roll of 35MM film, automatically retaining all density and detail variations. It will also record photographs, specimens, case histories and charts perfectly.

HOLD A FILING CABINET IN THE PALM OF MY HAND???

Yes, a three-drawer filing cabinet of radiographs can be recorded on two small rolls of film which fit in the palm of your hand. You save the cost of a filing cabinet, filing envelopes, plus the value of the films salvaged. Even after subtracting the cost of labor and film for recording, you save approximately $112.00 for each cabinet recorded.

Now anyone can record x-rays with densities perfectly controlled, using our simple panel board and its foolproof automatic controls.

Distributed by the major x-ray companies and their dealers.

Write for further information.

MICRO X-RAY RECORDER, INC.

1941 N. Western Ave. Chicago 47, Ill.

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. 61 FEBRUARY, 1949 No. 2

CONTENTS

Some Medical and Roentgenological Aspects of Mass Chest Surveys . . . . . ARTHUR C. CHRISTIE, M.D. 147

The Value of Roentgenology in the Prognosis of Minimal Tuberculosis . . . . . ARCHIBALD L. COCHRANE, HAROLD W. CAMPBELL, AND SAMUEL C. STEIN 153

Vertebral Angiography . . . OSCAR SUGAR, LAWRENCE B. HOLDEN, AND CHESTER B. POWELL 166

The Detection of Gastric Carcinoma by Photofluorographic Methods. Part I. Introduction . . . . . JOHN F. ROACH, ROBERT D. SLOAN, AND RUSSELL H. MORGAN 183

The Detection of Gastric Carcinoma by Photofluorographic Methods. Part II. Equipment Design . . . JOHN F. ROACH, ROBERT D. SLOAN, AND RUSSELL H. MORGAN 188

The Azygos Lobe: Its Involvement in Pulmonary Disease . . . . . EMIL ROTHSTEIN, M.D. 195

Occurrence and Diagnosis of Dilatation of the Aorta Distal to the Area of Coarctation . . . . . FELIX G. FLEISCHNER, M.D. 199

Left Atrial Calcification in Rheumatic Heart Disease . . . . . BERNARD S. EPSTEIN, M.D. 202

A Case of Bronchial Adenoma without Signs of Bronchial Obstruction, Concomitant with Minimal Pulmonary Tuberculosis . . . . . CAPTAIN GILBERT H. FLETCHER, M.C., AND MARION S. LOMBARD 209

Intraluminal Diverticulum and Other Lesions Producing Intermittent Duodenal Obstruction or Stasis . . . . . RICHARD E. KINZER, M.D. 212

The Roentgen Manifestations of Pancreatitis Complicating Mumps . . . . . M. H. POPPEL, M.D., F.A.C.R., AND CELIA BERCOW, M.D. 219

Demonstration of Sinus Tracts, Fistulas and Infected Cavities by Lipiodol . . . . . MAJOR JAMES M. DELL, JR., M.C. 223

Principles of Fast Electron Therapy in Cancer . . . . . ERICH M. UHLMANN, M.D., F.A.C.R., AND LESTER S. SKAGGS, Ph.D. 232

Part Time Radiological Practice in Hospitals of Small Cities . . . . . WILLIS S. PECK, M.D. 236

Department of Technique

Contribution to the Technique of Bronchography in Adults . . . . . L. WALK 243

Malleable Cones for Roentgen Therapy . . . . . ROBERT S. LEIGHTON, M.D. 245

Editorials

Legg-Perthes' Disease . . . . . RALPH S. BROMER, M.D. 248

Hirschsprung's Disease 250

William Gregory Cole, 1902–1948 . . . RAMSAY SPILLMAN, M.D. 252

Society Proceedings, Correspondence and News Items 254

Abstracts of Roentgen and Radium Literature 261

GENERAL INFORMATION

Manuscripts offered for publication and other correspondence relating to the editorial management and books for review should be sent to Dr. Lawrence Reynolds, Associate Editor, 110 Professional Building, Detroit 1, Michigan. Contributions may be sent in foreign languages and will be translated if found acceptable. Original articles are published with the understanding that they are contributed exclusively to THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY.

A certain number of illustrations will be supplied free of cost; but special arrangements must be made with the Associate Editor and Publisher for excess illustrations and elaborate tables.

Fifty reprints are furnished without charge to authors. Additional reprints may be purchased according to a scale of prices that accompanies galley proofs.

Correspondence regarding subscriptions, advertisements, and other business relating to THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY should be addressed to Charles C Thomas, Publisher, 301–327 East Lawrence Avenue, Springfield, Illinois.

Subscription price a year: $10.00, United States, Mexico, Cuba, Central and South America; $11.00, Canada; $12.00, other countries. Current single numbers, $1.50.

Manuscripts should be typewritten, with double spacing, and good margins (not on thin paper) and the *original* should be sent to the Associate Editor. The author should keep a carbon copy, as the original is not returned. The name of the author should appear on each sheet of manuscript. Tabular materials should be typed on separate sheets; likewise bibliographical lists, footnotes, etc.

Drawings and charts for reproduction should be made in black (*never* in blue). Photographic prints of plates or slides on glossy paper produce the best half-tones.

All photographs and drawings intended for illustrations should be numbered, the top plainly indicated, and an abbreviated title of the paper placed on the back of *each one*.

Legends for illustrations should be typewritten in a single list, double spaced, with numbers corresponding to those on the photographs and drawings, instead of attaching each legend to its corresponding figure.

Care in preparation of bibliographies will save much time and correspondence. Each reference in a bibliography should include the following information in the order indicated: Name of the author with initials; title of the article; name of the periodical; year, volume, and pages. It is requested that the authors use the following as a model:

1. Olcott, C. T., and Dooley, S. W. Agenesis of the lung of an infant. Am. J. Dis. Child., 1943, 65, 766–780.

The month should be given if the reference is to an issue of the current year. An alphabetical arrangement of authors is preferred.

The author should always place his full address somewhere on his manuscript. This is very important and is often omitted.

For information regarding membership in the American Roentgen Ray Society, address the Chairman of the Executive Council, Dr. Hugh F. Hare, 605 Commonwealth Ave., Boston 15, Massachusetts.

For information regarding the program of the annual meeting of the American Roentgen Ray Society, address the President-Elect, Dr. U. V. Portmann, Cleveland Clinic, Cleveland 6, Ohio.

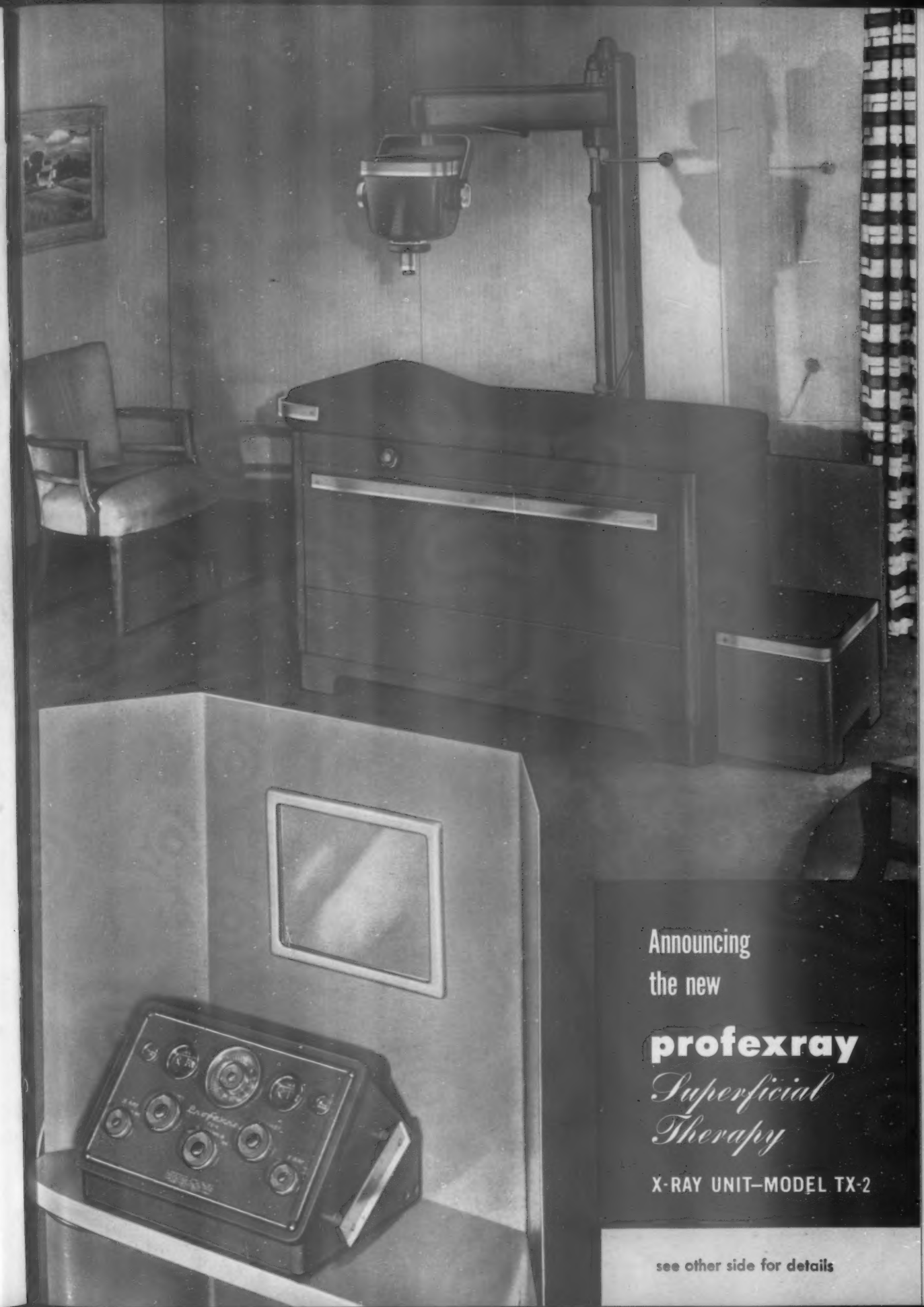
For information regarding membership in the American Radium Society, address the Secretary, Dr. Hugh F. Hare, 605 Commonwealth Ave., Boston 15, Massachusetts.

For information regarding the program of the annual meeting of the American Radium Society, address the President-Elect, Dr. William S. MacComb, 962 Park Ave., New York 28, N. Y.

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY is owned, maintained by, and in the interests of, the American Roentgen Ray Society, Inc. It is issued monthly by Charles C Thomas, Publisher, 301–327 East Lawrence Avenue, Springfield, Illinois. THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY does not hold itself responsible for any statements made or opinions expressed by any contributors in any article published in its columns.

Entered as second-class matter February 10, 1930, at the postoffice at Springfield, Illinois, and Menasha, Wisconsin, under the Act of March 3, 1879. Accepted for mailing at the special rate of postage provided for in the Act of February 28, 1925, embodied in Paragraph 4, section 438, P.L. and R. authorized February 10, 1930. Delivery is not guaranteed. Replacements are not guaranteed nor promised, but will be attempted if extra single copies are available and only if requested within 30 days from first of month following publication (17th of month) for domestic subscribers and 60 days for foreign subscribers. A 30 day notice of a change of address is requested. When ordering a change of address, send the Publisher both the old and new address.

Copyright 1949 by American Roentgen Ray Society, Inc. All rights reserved. This issue may not be reproduced, in whole or in part, in any form (except by reviewers for the public press) without written permission from the publisher.



Announcing
the new

profexray

Superficial Therapy

X-RAY UNIT—MODEL TX-2

see other side for details

...continued from preceding page

... as ideally **versatile**

as it is *beautiful*

No word picture need be added to the color photograph on the foregoing page to describe the blue and gold beauty of this new therapy unit. But there is a good deal to say about its functional perfection.

To begin with, the pictures on this page suggest the effortless ease with which radiation may be directed to any part of the anatomy . . . with perfectly relaxed comfort for the patient. Such easy positioning results largely from the brilliant design of the power head.

High voltage oil immersed

The compact, streamlined power-head encloses the *entire high voltage system* including tube and transformer, immersed in oil. Thus at one stroke, the danger from shock and the problem of managing cumbersome, high tension cables have been entirely eliminated. Oil immersion also minimizes the effect of variable atmospheric conditions.

Automatic precision control

The 45 degree target angle and 30 degree window opening provide a remarkably homogeneous radiation pattern at all normal treatment distances. Close control of dosage is further facilitated by the easily operated control panel. It provides 12-step KVP selection up to 100 KVP, continuous MA control from 2 to 10 MA, and quick-reading meters. The synchronous precision timer is calibrated in seconds from 1 second to 55 minutes.

No special construction or wiring

The control unit, within its control booth, may be placed opposite the treatment table at any convenient distance or angle. Therefore, no special construction is needed . . . and no special wiring, since the unit connects to any 110/120 volt 50/60 cycle A.C. electrical outlet.

From every point of view . . . sheer beauty, ease of operation, therapeutic efficiency . . . PROFEXRAY constitutes the ideal superficial therapy unit. Exceptionally liberal guarantees apply to both the unit itself and to the tube. The price . . . so astoundingly low . . . is made possible by mass production. The coupon below brings complete information . . . without cost or obligation.

PROFESSIONAL EQUIPMENT COMPANY
615 S. Peoria St., Chicago 7, Illinois

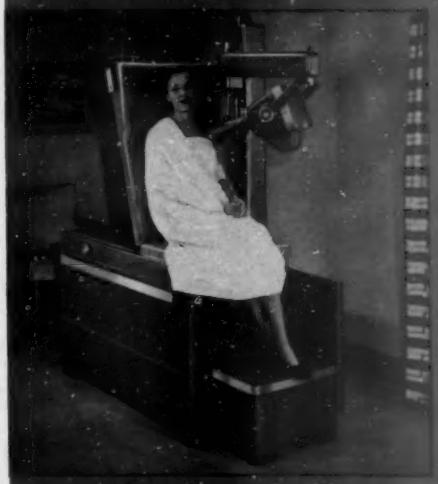
Gentlemen: Please send complete information on the PROFEXRAY Superficial Therapy Unit. No obligation.

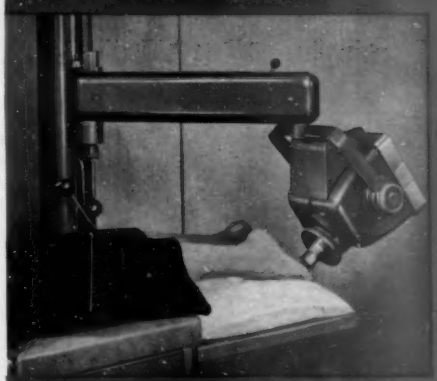
Name_____

Address_____

City_____ State_____

AJR





profexray

Superficial Therapy

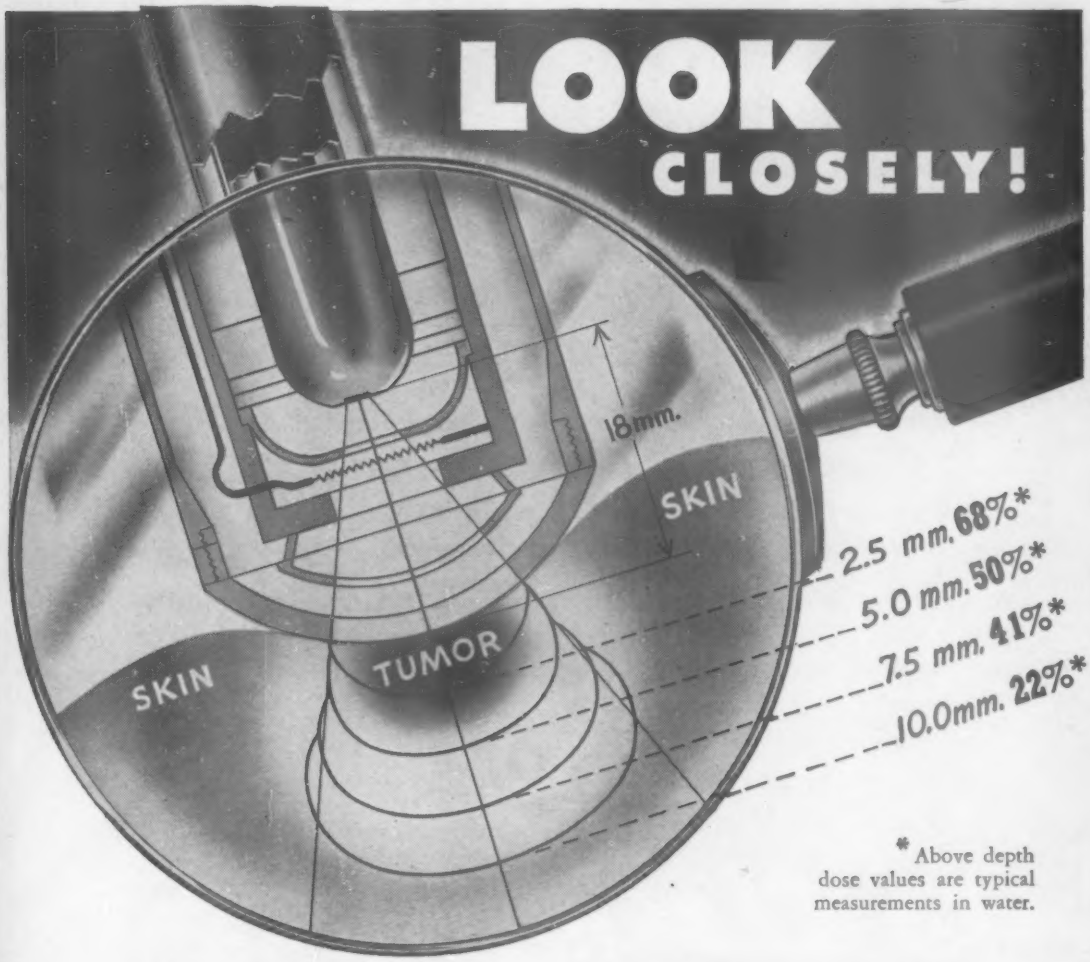
X-RAY UNIT—Model TX-2

$1295 F.O.B. CHICAGO

Including foot ramp, one cone and one filter

OPTIONAL ACCESSORY
Control Booth $150

MORE THAN 12,000 **profexray** DIAGNOSTIC X-RAY UNITS IN USE THE WORLD OVER



*Above depth dose values are typical measurements in water.

IDENTICAL APPLICATIONS whether SUPERFICIAL or ORIFICIAL
no other apparatus provides both these features

The outstanding result gained with Philips Contact and Cavity Therapy Units is due to the extremely short focal-skin distance, obtainable only with the Philips tube.

1. Low kilovoltage, constant potential and low inherent filtration are combined with short focal-skin distance.
2. Advantage gained through Inverse Square Law provides rapid diminution of depth dose.
3. The only X-ray tube and Unit specially designed for orificial applications.

Request further details. We will gladly supply Bulletin B-1012, without obligation.

NORTH AMERICAN PHILIPS COMPANY, INC. Norelco

Medical X-ray Apparatus

DEPT. XA-2, 750 S. FULTON AVENUE, MT. VERNON, N. Y. ★ IN CANADA: PHILIPS INDUSTRIES LTD., 1203 PHILIPS SQUARE, MONTREAL

Quality Right
Designed Right

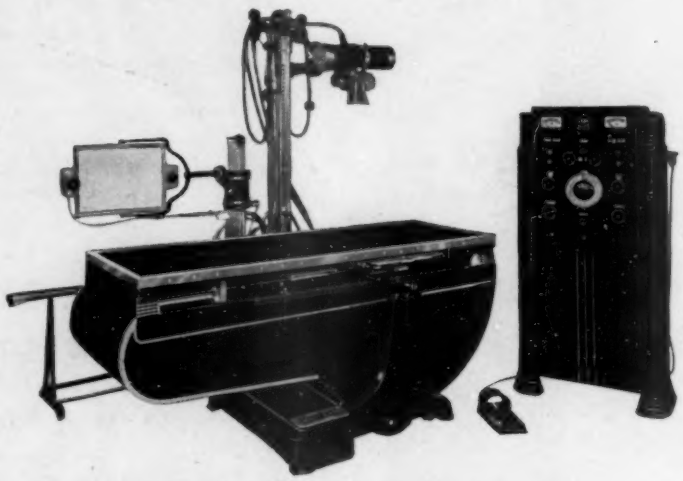
MATTERN
X-RAY
CHICAGO

Priced Right
Sold Right

One sure way to insure your X-Ray Unit investment is to buy a "Mattern."

For in this ultra-modern X-Ray Equipment YOU buy lasting value. You buy styling that will still be OUT AHEAD when many of today's X-Ray Units have been obsoleted by their own manufacturers.

At the same time you buy postwar engineering. Mattern Know-How makes better X-Ray Units. It's the tradition which demands perfection of design and highest quality materials.



DGS-200-200 Rotating Anode
Two Tube Unit

Your local "Mattern" dealer is anxious to tell you more about this new unit, or write us direct.

F. MATTERN MFG. CO. 4637-59 N. CICERO AVE.
CHICAGO 30, ILLINOIS

R.U.Q.

Signs and symptoms referable to the right upper quadrant can be clarified by a cardinal diagnostic step—oral cholecystography with PRIODAX.* With this simple procedure, the diagnosis of chronic gallbladder disease can usually be definitively made or ruled out. Such precision stems from the rapid and almost complete absorption of PRIODAX.

With PRIODAX, the normal gallbladder is clearly and distinctly visualized; whereas nonvisualization or faint visualization almost always indicates cholecystic disease. Due to its optimal radiopacity, gallstones show up well, either as negative shadows (if radiolucent) or as shadows denser than the surrounding PRIODAX (if radiopaque).

PRIODAX

(BRAND OF IODOALPHIONIC ACID—SCHERING)

Patient tolerance to PRIODAX is excellent, untoward reactions such as severe nausea and vomiting are seldom encountered. Loss of the medium is thus avoided and diagnostic accuracy consequently enhanced.

PACKAGING: PRIODAX, beta-(4-hydroxy-3, 5-diiodophenyl)-alpha-phenyl-propionic acid, Tablets are available in envelopes containing six 0.5 Gm. tablets (1 dose); boxes of 1, 5, 25 and 100 envelopes. Hospital Dispensing Package containing 4 rolls of 250 tablets each.

*℞

SCHERING

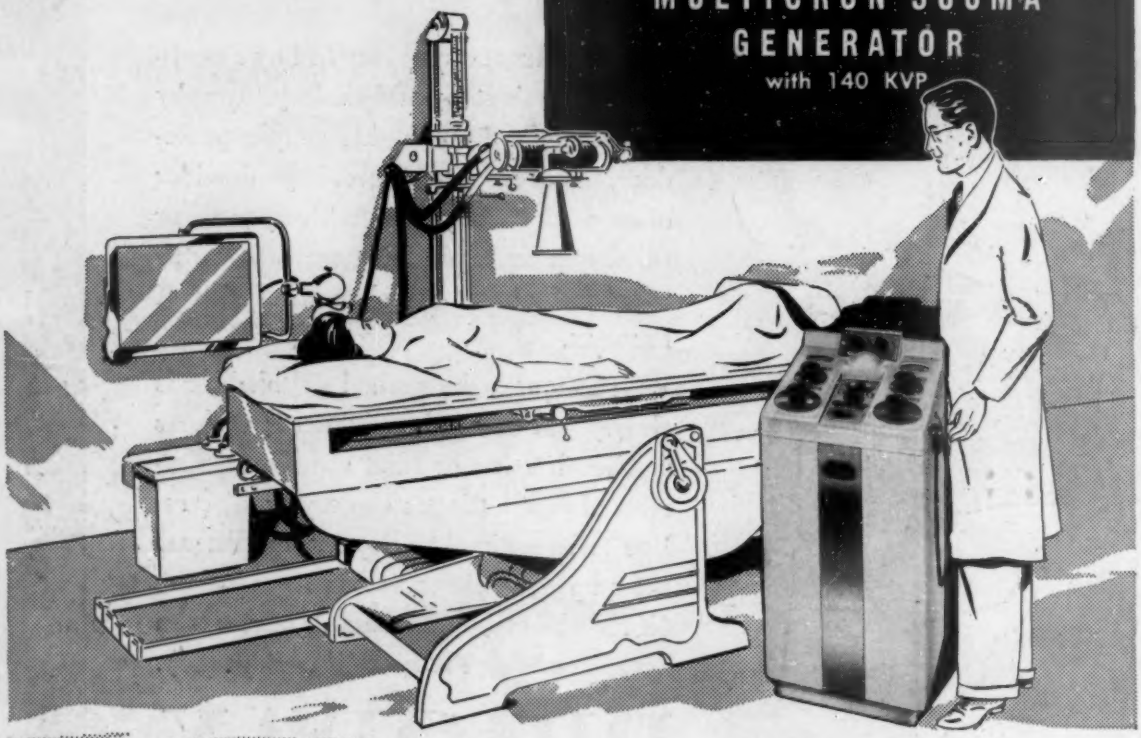
Schering CORPORATION · BLOOMFIELD, N. J.

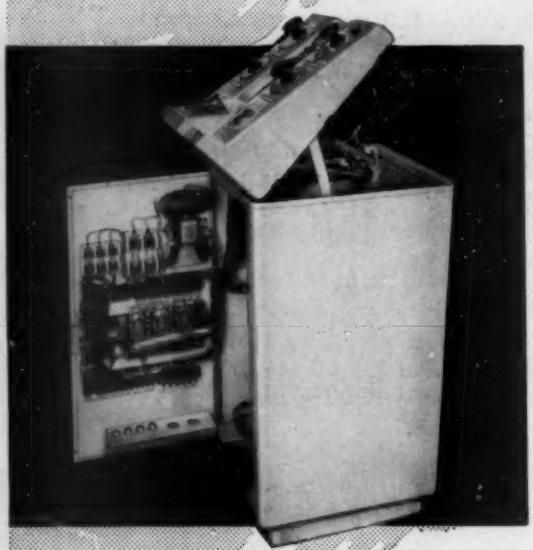
IN CANADA, SCHERING CORPORATION LTD., MONTREAL

PRIODAX

new possibilities for the radiologist

the
KELLEY-KOETT
MULTICRON 300MA GENERATOR
with 140 KVP

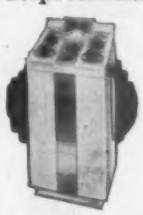




THE Kelley-Koett Multicron 300 MA is a heavy duty X-ray generator with capacity and operating features surpassing any previous diagnostic unit yet available in its range.

The therapy rating is 140 KVP at 10 milliamperes for four hours of continuous operation. Diagnostic rating provides 120 KVP at 300 milliamperes in intermittent operation. Fixed milliamperage control and a unique electronic-mechanical timer make operation outstandingly simple . . . results extremely accurate in every technic.

These and other features of interest to the radiologist are detailed in descriptive literature available on request. See your Kelley-Koett Representative or write us direct.



Instantly accessible, integral units make the Multicron 300 MA unit easy to adjust and service.

The KELLEY-KOETT Manufacturing Co.
2052 WEST FOURTH ST. COVINGTON, KY.

how good will the radiograph be?

PAINSTAKING effort may be completely wasted—if your cassettes are worn or inadequate. In a cassette, no factor is more important than uniform contact between film and screen.

Every radiograph made with a Keleket "Equi-Contact" Cassette is uniformly accurate . . . sharply detailed over every inch of the film surface (within the capacity of your X-ray unit). This has been accomplished by means of Keleket's exclusive "floating-type" hinges and unique spring arrangement. And these cassettes—made entirely by Kelley-Koett—eliminate troubles common with the ordinary cassette.

If your radiographs lack necessary sharpness, check your cassettes with your Kelley-Koett representative, or write us direct.

The KELLEY-KOETT Manufacturing Co.

2052 WEST FOURTH ST. COVINGTON, KY.

A G-E technical consultant

He can help you with routine problems on his periodic visits — yet is no further away than your telephone for consultation at any time. He can furnish technical advice on darkroom layout and procedures; analyze your supply and service problems. He will help your x-ray department run efficiently and economically with a minimum of attention from you.

He will gladly outline a control plan that will keep your supply room shelves adequately stocked . . . will save you dollars through quantity purchases. He will arrange, if you wish, for inspection and repair of your x-ray equipment . . . thus saving you the wasted time a breakdown entails.

He will introduce you to a simple, memory-jogging method of ordering routine supplies. He will arrange for adequate reserves to be carried close at hand to cover your future needs.

He will place at your disposal the resources of the world's largest manufacturer and distributor of x-ray equipment and supplies . . . General Electric X-Ray Corporation.

All this he will do without charge. He is your G-E salesman. Let him help you. He is always glad to serve.

GENERAL ELECTRIC
X-RAY CORPORATION

General Electric X-Ray Corporation manufactures and distributes x-ray and electromedical supplies and accessories; x-ray apparatus for medical, dental and industrial use; electromedical apparatus.

is as close as your telephone

"Patterson" Hi-Speed SERIES 2 Combination Intensifying Screens

for greater speed with detail

The "Patterson" Hi-Speed (Series 2) Intensifying Screen meets a long-felt radiographic need for increased speed with detail.

The screen is produced with an entirely new luminescent chemical. It offers several significant advantages to radiologists. Shorter exposures are possible, and these minimize the effect in the radiograph of involuntary action, bodily function, or movement on the part of an uncooperative patient. Hi-Speed (Series 2) Intensifying Screens also enlarge the scope of low-voltage equipment such as the portable type.

Using the Hi-Speed Screen, an exposure of only 100 MAS at 70 KVP will give the same radiographic results as an exposure of 150 MAS at 70 KVP with the Par-Speed Screen.

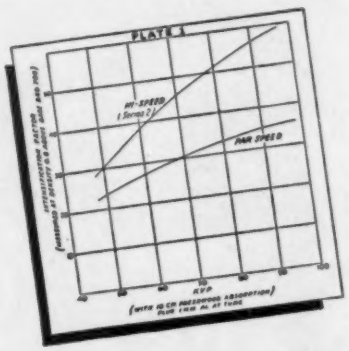


PLATE 1 (above) shows intensification factor of the HI-SPEED (Series 2) Screen in relation to the Par-Speed Screen.

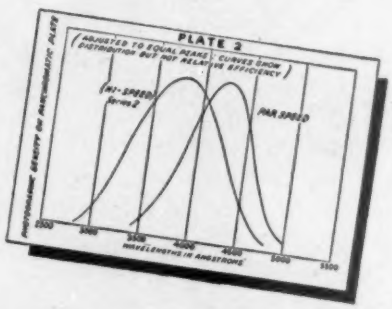


PLATE 2 indicates distribution of fluorescence of the HI-SPEED Screen is from 2800 to 4600 Angstroms. Note that the maximum response occurs below the visible at 3800.

Complete information about this valuable contribution to the science of radiology will be mailed upon request. E. I. du Pont de Nemours & Co. (Inc.), Patterson Screen Division, Towanda, Pa.

"Patterson" X-ray Screens

Intensifying . . . Fluoroscopic

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. 61 FEBRUARY, 1949 No. 2

SOME MEDICAL AND ROENTGENOLOGICAL ASPECTS OF MASS CHEST SURVEYS*

By ARTHUR C. CHRISTIE, M.D.

WASHINGTON, D. C.

CASE-FINDING has been recognized for a long time as one of the chief means of tuberculosis control, and roentgen examination of the chest is the one dependable and accepted method for case-finding. Photofluorography is now perfected to such a degree that mass surveys of very large units of the population are entirely practical. By "mass survey" we mean examination of the entire population, above fifteen years of age, of an entire city, county or state. Only a few such surveys have yet been made, the largest being the one which was carried out in Washington, D.C. from January 12 to July 1, 1948. A complete analysis of the results of the Washington survey will not be available for several months and the statistics given in this paper must be considered tentative and subject to future revision. Nevertheless, valuable experience was gained in the course of the survey and some conclusions are already justified. It is the purpose of this paper to try to make them available to others for guidance in similar surveys which are now being organized.

A total of 503,398 individuals had 70 mm. films made during the survey but at the present time only 454,114 are susceptible of the tentative analysis here presented. Elimination of 13,623 unsatisfactory films leaves a net total of 440,491 70 mm. films which were interpreted with the results given in Table I.

TABLE I

	Number	Per Cent
Total 70 mm. films interpreted	440,491	100.0
Negative	423,577	96.2
Total abnormal findings	16,403	3.8
Definite tuberculosis	4,405 (1.0%)	
Suspected tuberculosis	6,166 (1.4%)	
Cardiac cases	2,537 (0.6%)	
Other pathology	3,806 (0.8%)	

The 16,403 cases with positive findings had 14 by 17 inch films made, of which 197 were unsatisfactory. The results of interpretation of the remaining 16,206 are tabulated in Table II.

A significant fact disclosed by the Washington survey is the relation of the total number of cases of tuberculosis disclosed by the survey to the cases registered at the local Health Department as tuberculosis. Of the more than 6,000 cases, only 567

* Presented at the Forty-ninth Annual Meeting, American Roentgen Ray Society, Chicago, Ill., Sept. 14-17, 1948.

were on the tuberculosis registry, leaving about 5,600 cases previously unknown to the Health Department of which number 83 to 85 per cent are in a minimal stage and about 10 per cent only moderately advanced.

The question has been raised recently as to the practical value of the mass survey method, which requires the examination of such a large number of non-tuberculous individuals to screen out a relatively small

Table II

	Number	Per Cent
Total 14″×17″ films	16,206	3.8
Negative	5,996	1.4
Tuberculosis	6,401	1.5
Total definite tuberculosis	5,352	1.3
Minimal	4,464 (83.4%)	
Moderately advanced	564 (9.8%)	
Far advanced	123 (2.3%)	
Other tuberculosis	241 (4.5%)	
Suspected tuberculosis	1,049	0.2
Cardiac cases	1,540	0.3
Other pathology	2,269	0.5

percentage of cases of tuberculosis. There seems to be little doubt of the value of a method which discloses over 5,000 people in a city the size of Washington who have tuberculosis, previously unknown, the great majority of them at an early stage of the disease. It is true that examination of selected groups of the population in which the incidence of tuberculosis is known to be high will yield much higher percentages of positive cases. The practice of examining the chest of all patients who are admitted to general hospitals is proving a fruitful case-finding method, and very recently reports have been made of the high incidence of tuberculosis among the patients who seek the advice of general practitioners. Any method that discloses cases of tuberculosis is valuable and should be used wherever practicable. There is little doubt, however, that the final control of tuberculosis will depend upon well organized, systematic mass surveys supplemented by persistent examination of selected groups in which the incidence is known to be high.

The aspects of the problem which needs the greatest emphasis at the present time is one which seems obvious but which in practice has not been dealt with in any systematic or adequate manner, that is, the follow-up, management and treatment of the individual patient once the disease is discovered. It must be increasingly appreciated that the finding of the case is only the beginning of a mass survey. The local Health Department must have a central place in tuberculosis control for the registry, hospitalization and laboratory service for the tuberculous patient, but the tendency to throw the entire responsibility for follow-up and management upon it must be combatted. One of the most important lessons learned in both the Minneapolis and Washington surveys is the fact that the success of a survey and the final control of tuberculosis is largely the responsibility of the medical profession. Such responsibility rests especially upon the general practitioner, the specialist in diseases of the lungs and the radiologist.

The physician's responsibility begins during the survey itself, not only to give invaluable assistance in the organized case-finding effort but to initiate the program for follow-up and management which must continue long after the actual survey is closed.

An essential part of the organization of a Mass Survey is the Medical-Technical Committee. Its chairman should be a member of the Executive Committee of the Survey and through him and appropriate subcommittee chairmen the Medical-Technical Committee can maintain an effective liaison with the Director of the Survey, the Operations Committee, the Publicity Committee, the local Health Department and the local Medical Society. For the Washington Survey the Medical-Technical Committee was organized into the following subcommittees:

I. Subcommittee of Medical Consultants.
II. Subcommittee on Medical Information.
III. Subcommittee on Diagnostic Standards.
IV. Subcommittee on Cooperation with the Medical Profession.
V. Subcommittee on Management of Positive and Suspicious Cases.
VI. Subcommittee on Nursing Service.
VII. Subcommittee on Social Service.

The *Subcommittee of Medical Consultants* consists of physicians qualified to advise the Director of the Survey on all matters of general medical policy; to give guidance and advice to the physicians who are interpreting the films and to those who are classifying the patients; and to provide consultants, either individual consultants or a medical board, in cases of unusual difficulty for which private consultants are not available. This subcommittee must continue to function for a long period, probably at least two years, after the Survey is finished to advise the Director of Tuberculosis of the Health Department concerning the management and classification of difficult cases. It should be stated here that in order to provide for continuity of policy and action it is advantageous that the Director of Tuberculosis of the local Health Department should be the Director of the Survey.

The *Subcommittee on Medical Information,* through its chairman, maintains close relations with the general Publicity Committee of the Survey and is the source of medical information for that committee and for other committee chairmen.

The *Subcommittee on Diagnostic Standards and Technique* is charged with the duties of establishing a system of standards and nomenclature for reports on the interpretation of films; to advise concerning the procedure to be followed in the roentgen examination of positive and suspicious cases; and to confer with and advise technicians on the technical problems which may arise.

The following standard nomenclature was adopted for the Washington Survey:

1. The findings on the 70 mm. film are reported as "negative" or "positive."
2. For report on impression of activity on the 14 by 17 inch film the following classification is used:
   a. Active { Minimal / Moderately advanced / Far advanced }
   b. Questionably active.
   c. Inactive.
   d. Questionably inactive.
   e. Activity to be determined.

It was agreed that the usual parenchymal and hilum primary tuberculosis complexes are not to be reported. Adoption of a uniform procedure for examination of positive and suspicious cases necessitates the use of form letters which must be carefully phrased in order to avoid ambiguity and to minimize misunderstanding on the part of patients and private physicians, and to prevent undue emotional disturbances on the part of patients. Formulation of such letters was one of the duties of the Subcommittee on Diagnostic Standards and Technique.

The *Subcommittee on Cooperation with the Medical Profession* is charged with duties which are essential to the success of a mass survey. Since a large percentage of tuberculous patients found in the survey are treated by private physicians, it is one of the most important duties of the Medical Technical Committee to secure cooperation of the general medical profession. The natural and most effective approach is through the local Medical Society. Approval and support of the Survey by the Tuberculosis Committee of the Medical Society should be followed by approval by the Executive Board and finally by the Society itself, and such approval should be made known to every member of the Society. The effort is facilitated if, as was the

case in Washington, the chairman of the Tuberculosis Committee of the Medical Society is also the chairman of the Subcommittee on Cooperation with the Medical Profession. It is also important to have the President of the Medical Society a member of the Executive Committee of the Survey. Information is disseminated to the members of the medical profession by means of editorials and news items in the local medical journal and bulletins and by letters mailed directly from time to time to every registered physician in the community, or enclosed with the regular or special notices sent out from the Medical Society office.

The *Subcommittee on Management of Positive and Suspicious Cases.* The main purpose of this committee is indicated by its name. Its functions are largely educational. It soon becomes apparent to anyone engaged in the work of tuberculosis control that there is great need for education of both the public and the general medical profession in modern methods of care of the tuberculous patient. Early in the Washington Survey this committee formulated in considerable detail recommendations for management and treatment of tuberculosis to the end that both clinic patients and those under the care of private physicians might have the benefit of the most recent knowledge and practice in the medical, nursing, and social service fields. A summary of these recommendations was sent to every registered physician and the complete recommendations were made available to any physician who requested a copy.

The following is an outline, necessarily brief, which indicates the scope of the committee's recommendations.

I. *Initial Report of Abnormal Findings to the Patient.* Following the 14 by 17 inch film each patient should be interviewed by a competent chest physician. His explanation should include:
   1. A brief explanation of the roentgen findings and what they *may mean.*
   2. Reassurance of the patient to allay *unreasonable* fears, without *minimizing* the serious nature of the lesion.
   3. An explanation of need for further clinical and laboratory study.
   4. A clear statement concerning the contagious nature of the disease, especially is sputum is positive.
   5. Explanation of need for reliance on advice of his physician.

II. *Clinical Study and Evaluation by the Private Physician or Public Health Clinic.*
   1. Clinical history.
   2. Physical examination.
   3. Additional chest roentgen studies. Fluoroscopy, laminagraphy, bronchography, etc.
   4. Tuberculin testing.
   5. Laboratory studies. Sputum, gastric lavage, etc.
   6. Special diagnostic studies. Bronchoscopy, biopsy.

III. *Nursing Investigation.*
   1. Contact investigation for source cases.
   2. To find evidence of spread to household or other associates.
   3. To identify health or economic conditions which may influence treatment or prognosis.
   4. To prescribe proper anticontagious regimens.
   5. To lay groundwork for subsequent observation and treatment, hospitalization, etc.
   6. To allay unreasonable fears.

IV. *Medical Social Work and Rehabilitation.*
   1. To provide for relief of economic distress.
   2. To assist in adjustment of family and household problems.
   3. Placement in suitable occupations.
   4. Provide for hospitalization when necessary.

V. *Treatment.*
   1. To provide standards for a clinical division between
      a. Hospitalization for treatment.
      b. Hospitalization for isolation.
      c. Home care and isolation.
      d. Clinical and roentgen observation.
      e. Discharge.
      f. Transfer for medical observation.

Under all of the above headings and sub-headings the committee's report gives detailed recommendations for proper procedures to be followed.*

The following observations and conclusions are based upon experience during and following the recent Washington, D. C. Chest Survey:

1. The ultimate effect of a chest survey campaign will depend largely upon the subsequent management and treatment of the cases disclosed by the Survey. This responsibility falls not only upon the local Health Department but particularly upon the physicians of the community.

2. Radiologists and chest physicians occupy key positions in the discovery, the differential diagnosis and the treatment of tuberculosis. Both should have an active part in the organization and conduct of case-finding campaigns and in subsequent plans for follow-up and management of the cases found. They have a special responsibility to assist in the dissemination of information to the general profession. Attention is directed especially to the following points:

a. Evaluation of a case with regard to activity and type of treatment to be instituted should not be based upon roentgen examination alone and never upon a single film.

b. Roentgen examination of the chest in frank or suspected tuberculous lesions is too often carried out in a casual or routine manner. Good stereoscopic films are important but the roentgenologist has not met his full responsibility in a case until he has exhausted every means that his method affords to throw every possible light on the extent and nature of the lesion. This includes comparison, whenever possible, with films previously made; routine examination in oblique and lateral projections and often in the lordotic posture; body section roentgenograms whenever there is the slightest question of the presence of cavity or tumor mass; and bronchography whenever indicated.

3. The differential diagnosis between tuberculous and non-tuberculous lesions must be approached with great care. Too many cases of atypical pneumonia are being diagnosed as tuberculosis and hurried into sanatorium treatment, and too often there is delay in operation on early bronchogenic carcinoma because atelectasis is mistaken for tuberculous consolidation. Such mistakes can usually be avoided by a proper appreciation of the value of the tuberculin test, the significance of the absence of tubercle bacilli in repeated examinations of the sputum and by more frequent bronchoscopic and biopsy examinations.

4. The Washington Survey has demonstrated a definite value of the mass survey in disclosing the presence of a considerable number of lesions within the chest other than tuberculosis. There were 1,540 cases (0.3 per cent of the total number examined) who showed definite abnormalities in the size and contour of the heart. All of these were referred to their physicians for further study. There were 2,269 cases, excluding the cardiac cases (0.5 per cent of the total number examined) who showed lesions other than tuberculosis. No definite statistics are available regarding these but some were diagnosed as bronchogenic carcinoma, some as lymphoblastoma, one as adenoma of a bronchus, two as solitary bronchogenic cysts, and several as bronchiectasis. The survey thus has a considerable value in disclosing diseases other than tuberculosis.

5. The Survey emphasized the great importance of education of the general practitioner in modern methods of diagnosis and treatment of tuberculosis. He must learn to appreciate the value and limitations of roentgen examination of the chest; the indications for special types of examination (tuberculin testing, laboratory

* The complete report will be published for general distribution in one of the Public Health Reports issued by the Tuberculosis Control Division of the United States Public Health Service.

tests, etc.); and the criteria upon which the type of treatment can be based. He must realize his responsibility to cooperate with the Health Department by making periodic reports and furnishing other data on cases under his care. He must inform himself of facilities available in his community in the nursing and social service fields for follow-up and care of his patients and make full use of such services.

6. Finally, the Survey served to bring home to general practitioner and specialist the fact that the physician as a citizen owes a duty to his community to take a leading part in efforts to establish adequate hospital and public health department facilities and personnel for the care of the tuberculous patients of the community.

1835 Eye St., N.W.
Washington 6, D. C.

DISCUSSION

Dr. W. Edward Chamberlain, Philadelphia, Pa. It augurs well for the future of our country when men of the caliber of Arthur Christie devote time and energy to the welfare of the public. Dr. Christie has put the emphasis where it belongs in this matter of mass roentgen surveys for tuberculosis case-finding, and the "follow-through" that is so important in this kind of work. It is reassuring to see that his findings agree with some observations that we have made in Philadelphia.

The roentgen appearance is, of course, the most important single factor in the follow-through of cases of tuberculosis, not only for case-finding, but in every other aspect of tuberculosis control. As Dr. Christie has said so well today, however, it must not be allowed to stand by itself. We get into all sorts of difficulties if we do not correlate with the roentgen findings all of the other evidence that can be used to throw light upon a case of suspected tuberculosis.

The most important single factor, as Dr. Christie has said, is the follow-through, the care of the case after it has been found by the survey. It is rather disconcerting to discover that after many years of intensive effort to obtain a proper setup for the follow-through or the follow-up of these cases, the work is still not being done very well.

In Philadelphia, we know where the emphasis should be placed, and we have tried very hard to get these cases properly taken care of, but we are still in difficulties because the medical profession doesn't yet understand what it is all about and the patients are still ignorant in many cases. Recently we had our eyes opened once more to the place where the emphasis has to be put, by a little experiment we carried out.

We decided to find out what had happened to 108 consecutive cases in which the roentgen evidence was rather frightening, cases that were deemed, on the 70 mm. film, to be really important. In this evaluation that took place about a year after the cases were discovered, we found such things as this: that only 25 of the 108 had ever been told that they must enter a hospital. We found that another 25 of the 108 cases had become completely uncooperative and would not even let the public health nurse or medical social worker or the doctor talk to them. A number of them had disappeared from view, never to be found again. I could go on and give you more details but here is the important thing. The follow-through had not been done skillfully and had not been done rapidly enough. You can't expect a human being to believe that what you are talking to him about is important if you allow a considerable delay to take place between the time the film is made and the time you first approach him. He is going to say, "If it is as important as you say, why did you let two or three months go by before you caught up with me?"

And there is yet another difficulty in this important work of tuberculosis control,—the fact that no two doctors seem to think alike on the question of what to do about a case of tuberculosis after the survey roentgen study has picked it out.

I want to say that this paper was timely and authoritative and it will help us to impress the public health authorities, in municipalities and in the nation, with the great importance of having a proper machinery for follow-up and follow-through *before* we begin to take roentgen survey films and find cases of tuberculosis.

Vol. 61, No. 2

THE VALUE OF ROENTGENOLOGY IN THE PROGNOSIS OF MINIMAL TUBERCULOSIS*

By ARCHIBALD L. COCHRANE, HAROLD W. CAMPBELL,† *and* SAMUEL C. STEIN
The Henry Phipps Institute, University of Pennsylvania
PHILADELPHIA, PENNSYLVANIA

RECENT reports have aroused much discussion as to the accuracy of estimation of activity in tuberculous lesions of minimal extent on the basis of interpretation of initial chest roentgenograms. In the current mass roentgen-ray survey programs such estimates are commonly made, although, as a rule, safeguarded with cautionary qualifications.

A well known and widely quoted paper by Birkelo, Chamberlain, *et al.*[1] on "Tuberculosis Case Finding" clearly indicates the fallibility of original estimates, pointing out that qualified roentgenologists differed greatly in their interpretation of individual roentgenograms, and that a roentgenologist often fails to confirm his own original diagnosis when he reads a roentgenogram unknowingly for the second time.

Recently Birkelo and Rague[2] have reviewed the subject on the basis of a study of 699 cases of minimal tuberculosis followed for two to five years, and they come to the conclusion that a relatively high degree of accuracy in determination of activity from the first roentgenogram is possible. Reproductions of roentgenograms from selected cases, which were in many instances microfilms, illustrate both their successes and failures in original estimate.

The following paper, representing the first of a projected series, deals with the same subject on a statistical basis. It presents a study of an even larger number of cases over a longer period of time.

The object in this series of papers is to examine the prognostic value of the various characteristics, roentgenological, symptomatological, socio-economic, and personal, which are involved in the interpretation of a minimal lesion. This paper is concerned solely with the prognostic value of the roentgenologist's diagnoses: "active," "of questionable clinical significance," and "inactive, of no clinical significance." An effort is made to determine whether the fate of persons placed in these three groups on the basis of roentgen diagnosis differed in any statistically significant way and, if so, to discover whether this difference was medically significant or compatible with a large error.

METHOD AND SCOPE OF STUDY

The data used in this study consisted of roentgenograms of all minimal cases diagnosed in the chest clinic of the Henry Phipps Institute from 1926 to 1945, inclusive, with the following exceptions:

1. Fourteen patients who had had previous treatment before coming to the Phipps Institute.
2. Thirteen patients whose original film readings at the Institute had been lost, or whose charts contained inadequate information.
3. Two Chinese patients who were omitted in order to limit the study to the two principal categories of white and Negro.

The number of patients studied totalled exactly 1,100; according to Table 1, these patients were rather evenly distributed among white and Negro males and females. The follow-up period for these patients ranged from one month to nineteen years.

These cases were judged to be of minimal extent on the basis of a classification of stage of disease made in 1938 of all Phipps Institute patients examined up to that date. Since then all roentgenograms have

* This study was aided by a grant from the Office of Naval Research.
† During the course of this investigation Doctor Campbell died. He was responsible for much of the organization of the study and collaborated in its prosecution with unfailing spirit as long as his strength permitted.

been classified and coded when read. The work involved in twenty years of coding was both difficult and laborious. Without it, however, this study would have been impossible.

From the 1,100 case histories, certain data relevant to the present paper were extracted.

1. *The classification in regard to clinical status* made by the roentgenologist at the time the first diagnosis of minimal tuberculosis was made. In general, only the first roentgenogram was considered; but if additional special roentgenograms were requested (apical or stereoscopic) or if the first was technically unsatisfactory, these were included with the first roentgenogram. Since 1938 all diagnoses have been classified at the time they were made, minimal lesions being coded as active, of questionable significance, and as inactive. Minimal cases diagnosed during this period presented no difficulty in classification and no possibility of personal error on the part of the authors. The other cases which were diagnosed before 1938 were classified in the same three groups on the following basis:

a. The only cases coded as active were those in which the roentgenologist in his written report had used one of these phrases, "This lesion is active," "This appears to be dangerous," "This requires treatment," or when the adjectives "soft" or "flocculent" had been used to describe the infiltration. In addition, those who had had a roentgenogram negative for tuberculosis less than one year before were included as active unless the roentgenologist definitely stated that the lesion seen was not active.
b. Only those cases were classified as inactive in which the phrase "of no clinical significance" was used in the comment, or the words "old," "fibrotic," or "hard" were used to describe the infiltration.
c. All other cases were classified as of questionable clinical significance.

TABLE I

CASES OF MINIMAL TUBERCULOSIS OF SPECIFIED ACTIVITY WHICH WERE INCLUDED IN THIS STUDY, CLASSIFIED BY SEX AND COLOR: HENRY PHIPPS INSTITUTE, 1926–1945

Sex and Color	Cases of Minimal Tuberculosis of Specified Activity			
	Total	Active	Of questionable significance	Inactive
Both rates	1,100	267	509	324
White	625	123	286	216
Male	320	50	152	118
Female	305	73	134	98
Negro	475	144	223	108
Male	274	80	134	60
Female	201	64	89	48

With such a technique the possibility admittedly exists that personal bias, as regards the value of roentgenology, might have influenced the classification. It is believed, however, that certain factors minimized this possibility. For example, one author who did the majority of the selections was a stranger to the clinic and the subsequent fate of a patient was unknown

to him upon his first reading of the roentgen report. Moreover, all doubtful cases were discussed by two or more of the authors and all 1,100 cases were carefully reviewed with this possibility in mind.

2. *The following dates and data expressing the number of months after the first diagnosis of tuberculosis:*

a. The date of the first roentgenogram showing progression to a moderately advanced stage (x)
b. The date of the last roentgenogram showing a minimal lesion (y)
c. The date of death, if due to tuberculosis (q)
d. The date on which the patient was last known to be alive (r)

From these dates the date of "corrected progression" was calculated from the formula:

$$y+\frac{x-y}{2}.$$

In the few cases where the patient died from tuberculosis before any roentgenogram showing a moderately advanced lesion had been taken, the date of "corrected progression" was calculated by simple proportion, using data from those of the same sex-color roentgenological group who had died. A factor was first calculated for each group from the formula $(x-y)/(q-y)$ and from this, "x" in any other case could be deduced when "q" and "y" were known. This factor is thought to be sufficiently accurate for the purposes of this paper. Only 13 such cases were included in the study.

From these figures two "rates" were calculated per 100 person-years of observation:

1. The number progressing to the moderately advanced stage (P rate).
2. The number dying from tuberculosis (D rate).

For the two rates different "observation" times were used, since it is clearly impossible to say without roentgenological evidence that a lesion has not progressed to the moderately advanced stage, though there may be good reason for believing that the patient is still alive. For this reason "x" and "y" were used in "P" rates and "q" and "r" in "D" rates.

In addition, "D" rates were calculated in another way on the assumption that the data covering deaths were nearly complete because of the excellent cooperation between the local division of tuberculosis and the chest clinic. Notification is sent to the Phipps Institute of all death certificates filed for persons dying of tuberculosis in the area, if there has been any record of previous association with the Institute. In addition, details of other such deaths occurring outside Philadelphia are often discovered during routine visits. For these reasons a death rate per 100 observation person-years for five years has been calculated, assuming that no other deaths from tuberculosis occurred. These two rates can be considered as maximal and minimal values; therefore, an average of these two rates has been used throughout the study. A similar line of argument does not hold for progressions.

It is recognized that some personal error exists in reading roentgenograms as showing a change to moderately advanced disease; moreover, a roentgenologist might unconsciously tend to improve his score by "overreading" those roentgenograms he had originally diagnosed active, when they approached the moderately advanced category. It is, however, necessary to have some intermediate reading since the number of deaths is statistically rather small.

The only practical alternative is to use Reisner and Downes'[3] "definite progressions," and this alternative is believed to be even more liable to error. This belief has been fostered by a recent demonstration of roentgenograms at the Central Cooperative Clinic, Temple University School of Medicine. This demonstration showed apparent "definite progression" within the minimal limits in roentgenograms taken of the same individual at a few minutes' interval as a result of a slight variation in technique.

While the material in this study is con-

fidently believed to be unselective, by including all minimal cases, whatever their follow up, the authors have been forced to face other difficulties. The problem is only partially solved by using rates per 100 person-years, since the probability of progressing differs considerably in the various years following diagnosis;* thus, every person-year of observation has not the same value in terms of "risk." The situation could have been improved statistically by including, for example, only those cases on which we had a five year follow up, but this policy would have led to a most undesirable degree of selection. It is believed that the error has been minimized by calculating the rates per 100 person-years for each year, but it is not a completely satisfactory solution.

Before considering the results, two further points must be made:

1. These roentgenograms were not read under experimental conditions; they were read in the normal course of the clinic's work and the patient's chart was usually available. This chart gives information as to age, sex, color, marital status, exposure to tuberculosis, medical history, and clinical examination. The results of sputum examination and tuberculin testing were not available at the time the roentgenograms were read. It is impossible at this time to determine whether the roentgenologist was helped or hindered by having this information. The extent to which it might have helped will be discussed in a later paper. This study is concerned with the practical value of roentgenology under clinic conditions.

2. This type of analysis is a severe test for a roentgenologist. In the first place he has only one roentgenogram from which to make up his mind. In the second he gets no credit for those cases of questionable significance which he diagnoses as becoming active after a period of observation during which treatment is refused and the disease progresses. In the third place a roentgenologist, statistically, conspires to hide the evidence of his success. Patients with active disease are advised to rest and successful treatment means that there is no progression. It is also true that successful treatment may conceal an error in cases in which the gravity was actually overestimated. In South Philadelphia, however, for psychological and socio-economic reasons, large numbers of patients with active

TABLE II

RATIO OF PROGRESSIONS TO PERSON-OBSERVATION YEARS* AND PROGRESSION RATES PER 100 PERSON-OBSERVATION-YEARS AMONG CASES OF MINIMAL TUBERCULOSIS OF SPECIFIED ACTIVITY, CLASSIFIED BY SEX AND COLOR

Sex and Color	Ratio of Progressions to Person-Observation Years*			Progression Rates per 100 Observation Years*		
	Cases of active minimal tuberculosis	Cases of minimal tuberculosis of questionable significance	Cases of minimal inactive tuberculosis	Cases of active minimal tuberculosis	Cases of minimal tuberculosis of questionable significance	Cases of minimal inactive tuberculosis
White						
Male	21:111.8	6:365.3	5:278.5	18.8	1.6	1.8
Female	25:197.0	14:356.0	1:264.6	12.7	3.9	0.4
Negro						
Male	35:143.8	16:182.7	0:120.8	24.3	8.8	0
Female	30:138.3	9:227.5	2:101.8	21.7	4.0	2.0

* Limited in each case to five years.

* See Figures 1 and 2.

minimal tuberculosis refuse treatment, and really adequate treatment is rare; therefore, it is probable that roentgenologists, in this one respect, fare better in estimating prognosis in South Philadelphia than elsewhere.

ANALYSIS OF FINDINGS

The Value of Roentgenology

Data for the four sex-color groups have been calculated separately to eliminate these variables. Table I shows the distribution among the various groups. Table II shows the number of progressions per 100 person-observation years in these groups. A limit of five years was placed on any individual observation period. Table III shows the death rates in a similar way. As previously explained, these are averages between the maximum and minimum values.

Figures 1 and 2 show the number of progressions per 100 person-observation years for each individual year, for the first five years after diagnosis, in the various groups. To save space, the numerical data for these figures have not been published, but they are available at the Henry Phipps Institute.

Both the orderly numerical descent in the tables and the striking differences in the curves suggest that these roentgenological estimates of activity have been of value at the Phipps Institute, but, before drawing definite conclusions, certain points must be investigated.

TABLE III

AVERAGED* DEATH RATES PER 100 PERSON-EXPERIENCE-YEARS AMONG CASES OF MINIMAL TUBERCULOSIS OF SPECIFIED ACTIVITY, CLASSIFIED BY SEX AND COLOR

Sex and Color	Cases of Active Minimal Tuberculosis			Cases of Minimal Tuberculosis of Questionable Significance			Cases of Inactive Minimal Tuberculosis		
	Number of deaths	Averaged* death rates	Average of—	Number of deaths	Averaged* death rates	Average of—	Number of deaths	Averaged* death rates	Average of—
White Male	3	1.3	{1.6 1.0	2	0.4	{0.5 0.3	—	0.1	{— 0.2
Female	4	1.5	{1.3 1.6	4	0.6	{0.8 0.4	—	—	{— —
Negro Male	25	5.4	{10.7 0.0	3	1.3	{1.1 1.4	—	1.5	{— 2.9
Female	14	4.1	{6.2 2.0	4	0.7	{1.4 0.0	1	0.4	{0.7 —

* See page 155 of text for explanation.

1. The correlation between "*D*" rates and "*P*" rates. As death is a much more definite measure than progression, it is important to know how closely the two measurements agree. This problem was studied by the following method: Expected deaths were calculated by applying the rates of progression to the exposure times for deaths and then reducing the results to the same numerical total as the deaths. The expected deaths were then compared with the actual deaths by chi squared.

Fisher's tables indicate that the probability of obtaining poorer agreement by chance is 75 per cent for whites (both

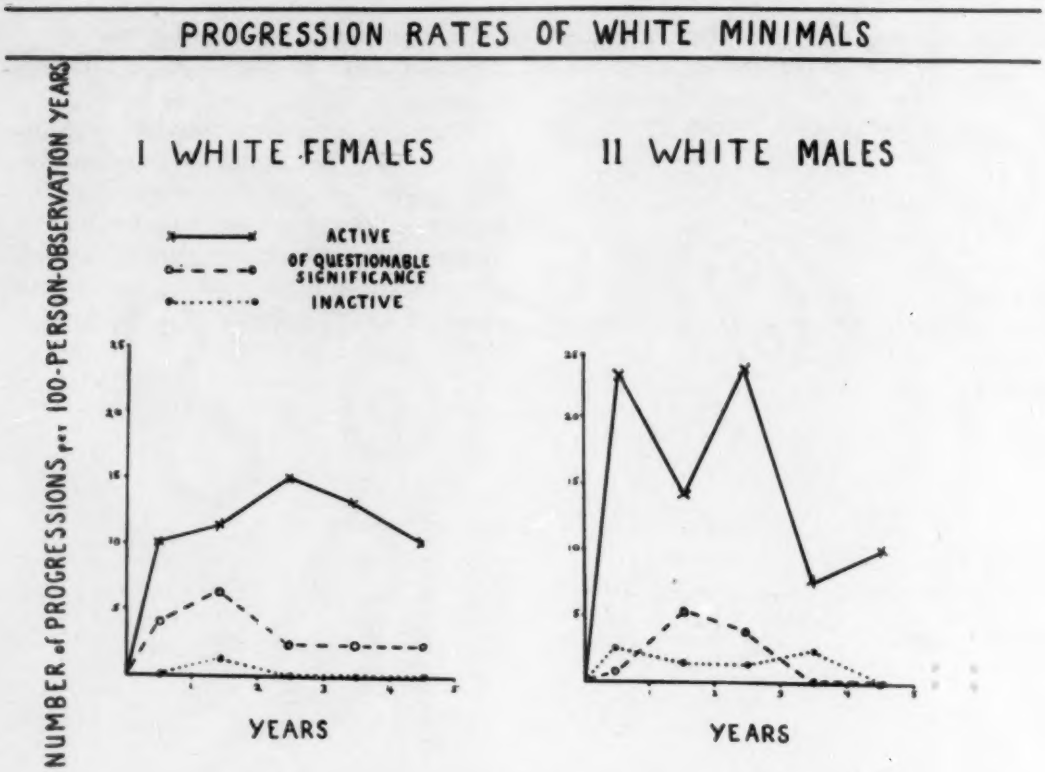

PROGRESSION RATES OF WHITE MINIMALS
NUMBER of PROGRESSIONS per 100-PERSON-OBSERVATION YEARS
I WHITE FEMALES
II WHITE MALES
ACTIVE
OF QUESTIONABLE SIGNIFICANCE
INACTIVE
YEARS
YEARS

FIG. 1

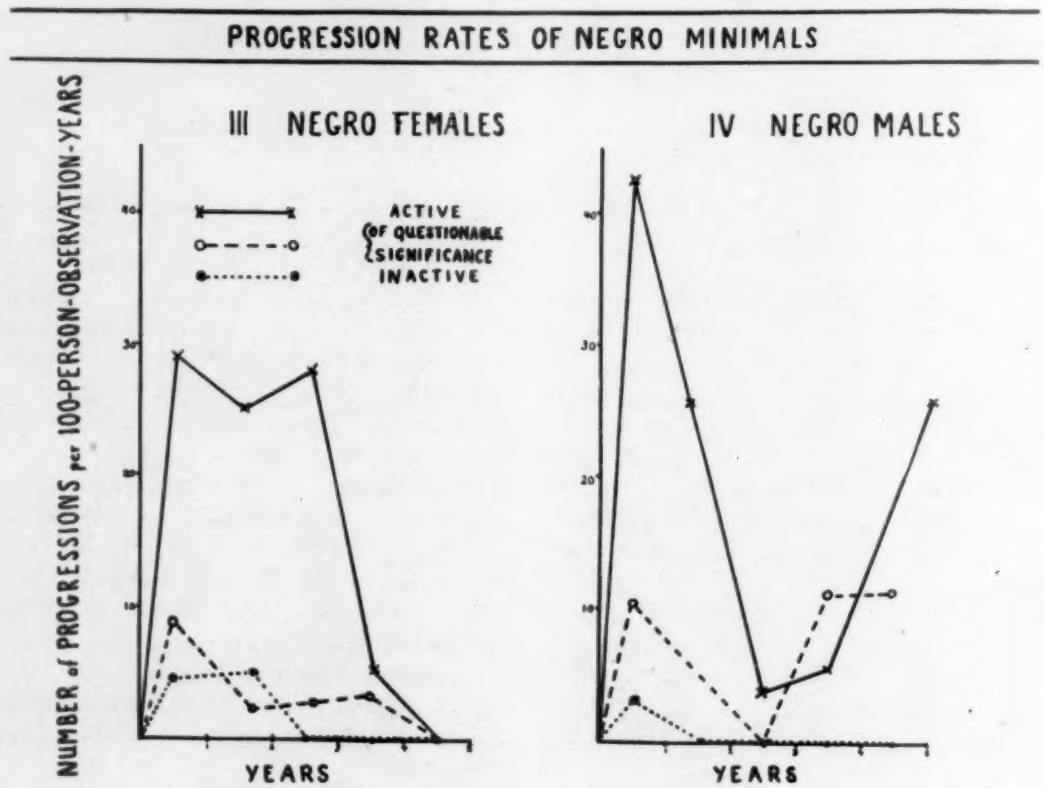

PROGRESSION RATES OF NEGRO MINIMALS
NUMBER of PROGRESSIONS per 100-PERSON-OBSERVATION-YEARS
III NEGRO FEMALES
IV NEGRO MALES
ACTIVE
OF QUESTIONABLE SIGNIFICANCE
INACTIVE
YEARS
YEARS

FIG. 2

sexes combined to give 5 degrees of freedom) and 15 per cent for Negroes. These results are perfectly consistent with the hypothesis that progression rates are a good measure of death rates and serve to strengthen the conclusions drawn from a detailed study of progression rates.

2. *Influence of case history on roentgenologist's diagnosis.* Among the four active groups a considerable number of cases were found which, when diagnosed, had had roentgenograms negative for tuberculosis less than one year before. In these cases it was thought that the history of the lesion as well as its flocculence might have influenced the roentgenologist. One does not suggest that skill is not required to distinguish these early lesions; it is a different type of skill, however, and as such should be investigated.

Table IV shows the summarized results of the "*P*" rates after subtraction of these cases with previous negative roentgenograms, and summarizes the corresponding "*D*" rates.

It is clear that the subtraction has made little general difference; the orderly numerical descent continues except in the case of the female white "*D*" rate where the number of deaths is very small. There seems no reason to believe that these cases have accounted for the roentgenologist's success.

3. *Extent to which the authors might unconsciously have helped the roentgenologist's score.* In spite of every precaution it is always possible that this bias might have happened. To investigate this possibility, the data were divided into the two decades 1926–1935 and 1936–1945. In the first decade all the cases were classified by the authors on the basis already described. In the second, the majority were coded at the time they were read by the roentgenologist while the remainder were diagnosed by the roentgenologist, using the same terminology as was later embodied in the code. The results are shown in Table V.

The most important feature is the regular numerical descent in the 1936–1945 decade, in which the division of the cases into the three groups was uninfluenced by the authors. Too much attention should not be paid to the differences and resemblances between the two decades. Many other factors varied in these two periods. One saw the depression; the other the full employment of war time. Roentgenological technique has improved and with it probably the accuracy in diagnosis of minimal

TABLE IV

EFFECT ON PROGRESSION RATES* AND DEATH RATES* OF EXCLUDING ACTIVE MINIMAL CASES WITH FILMS NEGATIVE FOR TUBERCULOSIS LESS THAN ONE YEAR BEFORE DIAGNOSIS, CLASSIFIED BY SEX AND COLOR

Sex and Color Active†	Progression Rates* Among Cases of Active Minimal Tuberculosis		Death Rates* Among Cases of Active Minimal Tuberculosis	
	Before exclusion	After exclusion	Before exclusion	After exclusion
White				
Male	18.8	18.1	1.6	1.6
Female	12.7	11.4	1.3	0.7
Negro				
Male	24.3	24.6	10.7	10.4
Female	21.7	19.7	6.2	5.4

* Per 100 observation years.
† Tables for "Of questionable significance" and for "Inactive" available at the Henry Phipps Institute.

lesions. It is probable, too, that theoretical ideas with reference to the treatment of minimal cases, if not always the practical results, have improved considerably during these two decades.

The question now arises as to what extent these various differences can be tested statistically for significance. The number of progressions and deaths per 100 person-years in five years has finally been chosen as the best figure for statistical treatments, though a case could be argued for a shorter period, particularly for the Negroes. The results are shown in Tables VI-A and VI-B.

Considering the small size of the groups, the number showing a ratio of difference to standard error of more than 2 is very striking. The lesser degree of significance among the death rates is to be expected because of the smaller number of deaths. The greater significance found among Negroes is presumably due to the fact that in this group treatment has interfered less with the natural history of disease.

The roentgenological interpretation of films of minimal lesions as carried out at the Phipps Institute has thus been of value in estimating prognosis. It appears to have been of greater value in differentiating between active cases and those of questionable significance than between the latter and inactive cases.

The Roentgenologist's Error

In determining such errors no rules are available for guidance, a fact which is in itself a silent witness to the medical profession's faith in the roentgen examination. Therefore, the following yardstick has been devised which, if anything, errs on the side of severity. The following are arbitrarily considered errors:

1. "Inactive" cases which progressed in five years.
2. Cases "of questionable clinical significance" which progressed in two years.
3. "Active" cases which in the absence of any treatment did not progress.

   The above three groups constituted the "minimal error" in diagnosis.
4. One must, however, consider the possible error concealed in those active cases which had treatment and which did not progress. No one knows what would have happened if they had had *no* treatment; therefore, such cases as the above must be included in order to calculate the "maximal error."

The results are shown in Tables VII and VIII which reveal, as was expected, a considerable error. This method of approach

TABLE V

PROGRESSION RATES AND DEATH RATES PER 100 PERSON-OBSERVATION-YEARS AMONG CASES OF MINIMAL TUBERCULOSIS OF SPECIFIED ACTIVITY, CLASSIFIED BY RACE AND DECADE STUDIED

Race and Decade Studied	Cases of Active Minimal Tuberculosis		Cases of Minimal Tuberculosis of Questionable Significance		Cases of Inactive Minimal Tuberculosis	
	Progression rates	Death rates	Progression rates	Death rates	Progression rates	Death rates
White						
1926–1935	15.8	1.3	2.5	0.7	0.7	—
1936–1945	13.3	1.7	3.3	0.3	3.0	—
Negro						
1926–1935	20.2	8.1	3.2	2.0	1.0	0.9
1936–1945	24.4	8.7	7.4	1.0	0.8	—

TABLE VI-A

SIGNIFICANCE OF DIFFERENCES BETWEEN THE PROGRESSION RATES PER 100 PERSON-OBSERVATION-YEARS AMONG CASES OF ACTIVE MINIMAL TUBERCULOSIS AND MINIMAL CASES OF QUESTIONABLE SIGNIFICANCE CLASSIFIED BY SEX AND COLOR

Sex and Color	Cases of Active Minimal Tuberculosis		Cases of Minimal Tuberculosis of Questionable Significance		Standard Error of Difference	Ratio of Difference to Standard Error
	Ratio of progressions to observation years	Progression rate	Ratio of progressions to observation years	Progression rate		
White						
Male	21:111.8	18.8	6:365.3	1.6	4.15	4.1
Female	25:197.0	12.7	14:360.9	3.7	2.74	3.3
Negro						
Male	35:143.8	24.3	16:182.7	8.8	4.66	3.3
Female	30:140.4	21.6	9:227.5	4.0	4.15	4.2

TABLE VI-B

SIGNIFICANCE OF DIFFERENCES BETWEEN THE PROGRESSION RATES PER 100 PERSON-OBSERVATION-YEARS AMONG MINIMAL CASES OF QUESTIONABLE SIGNIFICANCE AND INACTIVE CASES OF MINIMAL TUBERCULOSIS, CLASSIFIED BY SEX AND COLOR

Sex and Color	Cases of Minimal Tuberculosis of Questionable Significance		Cases of Inactive Minimal Tuberculosis		Standard Error of Difference	Ratio of Difference to Standard Error
	Ratio of progressions to observation years	Progression rate	Ratio of progressions to observation years	Progression rate		
White						
Male	6:365.3	1.6	5:278.5	1.8	1.05	−0.2*
Female	14:360.9	3.7	1:264.6	0.4	1.10	2.6
Negro						
Male	16:182.7	8.8	0:120.8	—	2.19	4.0
Female	9:227.5	4.0	2:101.8	2.0	1.92	1.0

* This is the only case in which the difference in rates contradicts the roentgenologist, and this difference is completely insignificant (significance at 5 per cent level is given by ratio of 1.96).

is, however, not wholly satisfactory, since no allowance is made for the degree of accuracy which would have been achieved by pure chance; e.g., if a roentgenologist blindly shuffled the roentgenograms of minimal cases into three boxes, he would inevitably toss some into the right one. Table IX shows the female white patients, classified by a roentgenologist's diagnosis and progression.

The "errors" appear with an asterisk in the upper right and lower left corners. These errors are not to be compared with those expected if roentgen diagnosis had no meaning—if roentgenological classification had no relation to later progression—in short, with the results expected from the "blind" roentgenologist.

To be fair to the Phipps roentgenologist, however, the "blind" roentgenologist should be forced to have 67 cases diagnosed as active, 119 questionable cases, and 73

diagnosed as inactive. Since the "blind" roentgenologist would assign diagnoses at random, each case would have 67 chances in 259 of being called active. Thus, of the 24 cases which progressed in two years, on the average one would expect 6.2 (67/259×24) to be called active. Table x shows the results obtained by proceeding in this way. The results of the diagnoses made by the Phipps roentgenologist and by the "blind" roentgenologist, as shown in Table xi, can now be compared.

The score is merely the percentage of the "blind" roentgenologist's errors which the Phipps roentgenologist avoided making. The perfect score is 100 and a score of 0 is no better than chance. A really bad diagnostic method would have resulted in negative scores.

For the other groups the Phipps roentgenologist did somewhat better on the average, as is shown in Table xii. The scores for each type of error differ substantially from group to group, but the

TABLE VII

ERRORS IN DIAGNOSIS OF SPECIFIED TYPE* AND NUMBER AT RISK,† CLASSIFIED BY SEX AND COLOR

Sex and Color	Inactive Minimal Cases		Minimal Cases of Questionable Significance		Active Minimal Cases		Active Minimal Cases Which Had Treatment and Which Did Not Progress
	Which progressed in five years	Number at risk†	Which progressed in two years	Number at risk†	Which did not progress**	Number at risk†‡	
White							
Male	5	78	4	122	5	43	17
Female	1	73	10	119	18	67	24
Negro							
Male	0	39	13	96	19	65	11
Female	2	29	7	73	12	54	12

* See description of errors 3 and 4 on page 160.
† Number at risk includes only those with a roentgenological follow up.
** In the absence of any treatment.
‡ Number at risk excludes those with inadequate data as to rest.

TABLE VIII

MAXIMAL AND MINIMAL ERRORS* IN DIAGNOSIS AND PERCENTAGE OF CASES AT RISK† WHICH WERE DIAGNOSED ERRONEOUSLY, CLASSIFIED BY SEX AND COLOR

Sex and Color	Cases of Minimal Tuberculosis at Risk†	Maximal Errors*		Minimal Errors*	
		Number	Per cent of cases at risk†	Number	Per cent of cases at risk†
White					
Male	243	31	12.0	14	5.8
Female	259	53	20.0	29	11.2
Negro					
Male	200	43	21.0	32	16.0
Female	156	33	21.0	21	13.5

* See description of errors 3 and 4 on page 160.
† Number at risk includes only those with a roentgenological follow up; those with inadequate data as to rest were excluded.

TABLE IX

CASES OF MINIMAL TUBERCULOSIS OF SPECIFIED ACTIVITY AMONG WHITE FEMALES,* CLASSIFIED BY PERIOD IN WHICH PROGRESSION OCCURRED

Period in Which Progression Occurred	Cases of Minimal Tuberculosis among White Females			
	Total†	Active	Of questionable significance	Inactive
Total	259	67	119	73
First two years after diagnosis	24	13	10**	1**
Next three years	16	12	4	0
Not in five years	219	42**	105	72

* Tables available for other groups at the Henry Phipps Institute.
† Total does not agree with Table 1 since inadequate follow-up cases (2 years) had to be excluded.
** Indicates a group of errors.

TABLE X

CASES OF MINIMAL TUBERCULOSIS OF SPECIFIED ACTIVITY AMONG WHITE FEMALES* WHICH WOULD HAVE BEEN DIAGNOSED BY A "BLIND" ROENTGENOLOGIST, CLASSIFIED BY PERIOD IN WHICH PROGRESSION OCCURRED

Period in Which Progression Occurred	Cases of Minimal Tuberculosis among White Females Which Would Have Been Diagnosed by a "Blind" Roentgenologist			
	Total	Active	Of questionable significance	Inactive
Total	259.0	67.0	119.0	73.0
First two years after diagnosis	24.0	6.2	11.0	6.8
Next three years	16.0	4.1	7.4	4.5
Not in five years	219.0	56.7	100.6	61.7

* Tables available for other groups at the Henry Phipps Institute.

TABLE XI

ERRORS MADE BY PHIPPS INSTITUTE AND "BLIND" ROENTGENOLOGIST* IN DIAGNOSING MINIMAL CASES OF TUBERCULOSIS AMONG WHITE FEMALES AND "SCORE" OF PHIPPS INSTITUTE ROENTGENOLOGIST, CLASSIFIED BY TYPE OF ERROR

Type of Error	Errors Made by Roentgenologist		"Score" (in Percentage) Made by Phipps Roentgenologist
	Phipps	"Blind"	
All types	53	79.0	42
Inactive cases which progressed in five years	1	11.3	91
Cases of questionable significance which progressed in two years	10	11.0	9
Active cases which did not progress†	42	56.7	26

* Tables available for other groups at the Henry Phipps Institute.
† See description of errors 3 and 4 on page 160.

TABLE XII

ERRORS MADE BY PHIPPS INSTITUTE AND "BLIND" ROENTGENOLOGIST IN DIAGNOSING MINIMAL CASES OF TUBERCULOSIS AMONG ALL SEX AND COLOR GROUPS AND "SCORE" MADE BY PHIPPS ROENTGENOLOGIST IN DIAGNOSING CASES IN SPECIFIED GROUP, CLASSIFIED BY TYPE OF ERROR

Type of Error	Errors Made by Roentgenologist		"Scores" (by Percentage) made by Phipps Roentgenologist in Diagnosing Cases in Specified Group				
	Phipps	"Blind"	All sex and race groups	Male white	Female white	Male Negro	Female Negro
All types	162	300.0	54	51	42	57	55
Inactive cases which progressed in five years	8	39.1	80	52	91	100	74
Cases of questionable significance which progressed in two years	34	56.5	40	60	9	38	52
Active cases which did not progress*	120	204.4	41	41	26	34	40

* See description of errors 3 and 4 on page 160.

samples are so small that the differences are not statistically significant.

In diagnosing inactive cases the Phipps roentgenologist's score was four-fifths of the way from blind chance to perfection, but in determining questionable and active cases his score was only two-fifths perfect. This result represents a good performance since the clinical desirability of an active diagnosis for a patient with probability one-half of progressing makes it inevitable that a competent roentgenologist will seem to overdiagnose active cases according to the definition of error. The earlier tables and discussion have shown how useful such performance can be clinically, even if it is far from perfection.

The figures from the paper of Birkelo and his colleagues[1] can be reanalyzed on a similar "blind" basis. The roentgenologists when "scored" as above for re-reading roentgenograms get a value of 70, which, as their task was easier, is in every way compatible with the results of this study. Although the details of this method are omitted from this report, they may be obtained either from Professor John Tukey at Princeton University or from the Henry Phipps Institute.

By both techniques it is clear that a considerable error exists in the roentgenologist's estimate of prognosis, but this finding in no way detracts from its value, as previously demonstrated.

SUMMARY

Eleven hundred cases of minimal tuberculosis, representing, with a few minor exceptions, all the cases of minimal tuberculosis diagnosed at the Henry Phipps Institute for the twenty years, 1926–1945, have been classified and followed up.

This paper has analyzed the results from the point of view of the prognostic value of the roentgenologist's opinion of activity at the time of the first roentgenogram. Both progression rates and death rates indicate that such opinions are of great value in determining the type of treatment for such cases.

The error of the roentgenologist has also been estimated by two different methods on the same roentgenograms. Both confirm the recently published opinion

that there is a considerable roentgenological error. The technique of comparison with the errors of a roentgenologist sorting roentgenograms blindly shows that the results are much better than those which would have been expected by chance; in particular, the error in the diagnosis of inactive minimal tuberculosis has been found to be small.

ACKNOWLEDGMENTS

This study is an end product of twenty years of cooperative work by all members of the staff of the chest clinic of the Henry Phipps Institute; among these staff members Dr. H. W. Hetherington should be mentioned particularly since he reported the majority of the roentgenograms on which this study is based.

The authors are also deeply indebted to Professor John Tukey, Consulting Statistician to the Office of Naval Research, and his colleagues of Princeton University for assistance in statistical analysis, to Miss E. Placentra for her assistance with the records, and to Dr. E. R. Long for critical review of the analysis at several stages in its development.

Henry Phipps Institute
Seventh & Lombard Sts.
Philadelphia 47, Pa.

REFERENCES

1. Birkelo, C. C., Chamberlain, W. E., *et al.* Tuberculosis case finding. *J.A.M.A.*, 1947, *133*, 359–365.
2. Birkelo, C. C., and Rague, P. O. Accuracy of roentgen determination of activity of minimal pulmonary tuberculosis. Am. J. Roentgenol. & Rad. Therapy, 1948, *60*, 303–314.
3. Reisner, David, and Downes, Jean. Minimal tuberculous lesions of the lung. *Am. Rev. Tuberc.*, 1945, *51*, 393–412.

VERTEBRAL ANGIOGRAPHY*

By OSCAR SUGAR, LAWRENCE B. HOLDEN, *and* CHESTER B. POWELL
CHICAGO, ILLINOIS

WHILE attempting to perform angiograms by the percutaneous method (Shimidzu[27], Green and Arana[8]) occasionally the vertebral artery has been punctured instead of the carotid. The information obtained from these accidental vertebral angiograms is sometimes very useful. Thus, at our institution a previously unsuspected metastatic carcinoma of the thalamus has been disclosed (Fig. 2a). In another patient, with a traumatic cavernous-carotid fistula, the extent of collateral circulation was demonstrated (Fig. 3b) rendering less difficult the decision to ligate a carotid artery.

Recently we subjected a patient (Case IV), in whom a ruptured aneurysm was suspected, to bilateral percutaneous carotid arteriography without demonstrating a lesion. The desire to study the vessels of the posterior fossa in that case led to the development of a successful technique of deliberate percutaneous vertebral angiography.

ANATOMY

The vertebral artery is the first branch of the subclavian artery. It ascends vertically to the foramen transversarium of the sixth cervical vertebra, through which it passes, to run in the corresponding foramina of the higher cervical vertebrae, anterior to the emerging cervical nerves. After passing through the foramen in the transverse process of the atlas, it turns behind the articular process and lies in the groove on the posterior arch of the atlas. The artery pierces the atlanto-occipital membrane and dura mater to enter the skull through the foramen magnum. It lies first lateral to, then anterior to, the medulla oblongata and joins its fellow from the opposite side at the lower border of the pons to form the basilar artery. This passes ventral to the midline groove of the pons to divide into its terminal branches at the upper end of the pons. The major intracranial branches of the vertebral artery are:

1. Anterior spinal artery—joining with the one of the opposite side to run in front of the anterior median sulcus of the spinal cord.

2. Posterior spinal artery—coursing down the dorsal surface of the spinal cord medial to the emerging dorsal roots.

3. Posterior inferior cerebellar artery—supplying the undersurface of the cerebellum, the medulla oblongata, and part of the pons.

The major intracranial branches of the basilar artery are:

1. Anterior inferior cerebellar artery—supplying the undersurface of the cerebellum.

2. Internal auditory artery—passing into the internal auditory meatus.

3. Pontine branches.

4. Superior cerebellar artery—passing around the cerebral peduncle to the upper surface of the cerebellum.

5. Posterior cerebral artery—passing parallel to the superior cerebellar artery (separated from it by the oculomotor nerve and the tentorium cerebelli) to supply the basal ganglia, occipital lobe, and the inferior gyri of the temporal lobe.

In its first or non-osseous cervical portion, the vertebral artery lies immediately behind the vertebral and jugular veins (and the thoracic duct on the left). It lies between the longus colli and the scalenus anticus muscles. As it passes through the transverse processes it is accompanied by a venous plexus of vertebral veins and by sympathetic nerve fibers. After it leaves the foramen of the transverse process of the atlas, it lies in the suboccipital triangle

* From the Department of Neurology and Neurological Surgery, University of Illinois College of Medicine at the Illinois Neuropsychiatric Institute, Chicago, Illinois.

before passing through the dura mater.

The posterior portions of the transverse processes of the cervical vertebrae are shaped so that they form a virtually unbroken column of bone and articular surfaces, which for practical purposes, is impenetrable. Anteriorly, however, there are gaps between the surfaces of the adjacent transverse processes amounting to as much as one centimeter, crossed by the intertransverse muscles which cover the vertebral artery and vein as these pass from foramen to foramen. Through these spaces the vertebral artery may be entered by a needle inserted from in front.

TECHNIQUE

The entire procedure of vertebral angiography is carried out in the X-ray Department. After suitable premedication the patient is anesthetized with sodium pentothal by intravenous drip (0.2–0.5 per cent solution) (Teplinsky, Harris, Cassels and Sugar[30]). This is done in the supine position, on a cart which can be raised or lowered at will. An intratracheal tube is inserted. Then, in order to extend the neck, two pillows are placed under the upper thorax and the head is supported on a radiolucent cup or on a board which projects horizontally from the end of the cart. The cart is then placed so that the side of the patient's head rests against the vertically placed plate holder of the special head unit. Alternatively, films may be taken with any horizontally beamed roentgen-apparatus containing a Bucky grid or with a cassette and a Lysholm grid.

The shaved skin of the neck is cleansed with alcohol sponges. The operator's left thumb is placed lateral to the upper margin of the thyroid cartilage, pressing firmly downward, effectively separating the carotid sheath and its contents from the trachea until the transverse process of the fifth cervical vertebra is palpated. It is then easy to insert the needle through the skin and underlying fasciae until it rests on bone. The thumb can then be withdrawn, allowing the tissues to spring back into place. It is usually easy to palpate the lateral extremity of the transverse process and the needle point is directed laterally to reach this tip for orientation; this is also done even if the transverse process cannot be palpated from the outside. The needle point is then shifted medially about a centimeter to bring it approximately over the region of the foramen transversarium. Now, as the needle is cautiously advanced the point slips over the anterior superior margin of the process yet under the anterior inferior margin of the process above. It then passes into the foramen itself, where it usually engages the vertebral artery. Occasionally, the artery is encountered as it passes from foramen to foramen. At times the needle will pass completely through the artery; it should always be withdrawn slowly, therefore, in order that this be recognized.

A sharp medium bevel 17-gauge 3 inch (8 cm.) straight needle is attached by means of a Luer-Lok observation tube to a 6 inch (15 cm.) rubber stethoscope-tubing, the other end of which is tied to a two-way stopcock. This is connected to a 20 cc. syringe containing a 2.5 per cent solution of sodium citrate in water. The tubing and needle are filled with the solution prior to insertion through the skin to minimize the dangers of clot formation in the needle and air embolism. When the vertebral artery is entered there is a rush of bright red blood into the observation tube. If permitted, this blood will push its way into the syringe with sufficient force to expel the plunger. When venous channels are encountered, no such rush or pressure occurs. If, for some reason, the injection is not made immediately after blood is encountered, it may be necessary to remove the needle and irrigate it before reinsertion.

When the artery has been encountered and the needle tip properly secured by the fingers of the operator, the assistant replaces the citrated solution with a syringe containing 20 cc. of a 35 per cent diodrast solution (using the two-way stopcock). The

stopcock is opened to make sure the needle is still in the vessel and the contrast medium injected as rapidly as possible. The signal for exposing the film is given by the assistant making the injection at the moment when all of the dye has left the syringe (5 cc. remain in the tubing). The syringe is exchanged for another containing either citrate or physiological saline solution, and the needle and tubing kept patent by slow injection of the solution. Meanwhile, the roentgen technician removes the exposed plate, inserts another, and changes the position of the tube for a stereoscopic film. The second injection is now made. If a phlebogram is desired a third film is exposed, with a delay of four to six seconds between injection and exposure. Obviously, fewer injections and less total contrast medium would be needed with appropriate rapid plate changers.

It is usually possible to make some changes in the position of the patient's head and neck after the needle is in place without disengaging the artery. Therefore, if an anteroposterior view is desired, the plate holder is shifted and placed under the head (or the head moved onto the plate holder). The timing for film exposure is altered,* and the plate is exposed at the end of the injection just as with the lateral views. The position of the roentgen tube and the plate varies depending on the type of anteroposterior view desired. Axial, true anteroposterior and occipital views reveal different aspects of the vertebral circulation (Fig. 1d and 6c).†

It is possible to do carotid and vertebral angiography one after the other, especially in search of an aneurysm which cannot be localized clinically. Up to six injections (120 cc.) of diodrast have been used without harm. There is enough time between the two sets of injections to prevent overloading of the circulation with diodrast. Patients with obvious kidney damage have not been subjected to arteriography as yet and the limits of tolerance are unknown.

When the films have been made the needle is withdrawn from the neck and a gauze held over the puncture wound with firm pressure and taped into place. The anesthesia is discontinued, the patient extubated, and returned to his bed, where the usual post-anesthetic watch is kept. An ice collar may be applied to the neck for swelling and codeine given for pain when the patient awakens. Ordinarily, these inconveniences are not encountered.

Figure 1a demonstrates a normal vertebral arteriogram seen from the side. Almost inevitably, the petrous bone and mastoid air cells obscure much of the circulation, but the following vessels can be demonstrated. In the neck is seen the cervical portion of the vertebral artery, usually straight in the foramina transversaria to the level of C_2 where there is a bend in the transverse plane before the vessel passes laterally to go through the atlas. Emerging from the first cervical transverse process the vessel has another lateral bend before it enters the cranium. The course within the head follows the clivus, diverging from the bone at the dorsum sellae to divide into the terminal posterior cerebral arteries. Just after passing through the foramen magnum, the posterior inferior cerebellar artery can be seen arising with a convoluted first portion. Just before the posterior cerebral arteries are formed may be seen the superior cerebellar artery, paralleling the cerebral vessel in the first part of its course. The smaller vessels seen in the upper portions of the posterior fossa and in the region of the occipital lobes are branches of these larger vessels. Frequently, with proper timing (Fig. 2b and 5) a haze of small vessels can be seen arising from the basilar-vertebral system, running forward into the thalamus. The main vessels of this group are the posterolateral

* The technical data for these exposures are as follows: (a) Lateral exposures: 55 kv., 100 ma., 0.5 second. (b) Axial or occipital exposures: 75 kv., 100 ma., 1.25 second. The head unit was specially devised at the University of Chicago, and uses a G.E. tube, fixed tube-casette holder distance of 36 inches, and Potter-Bucky diaphragm.

† Because the rubber intratracheal tube is radiopaque, it is better to use a plastic intratracheal tube for angiography in case anteroposterior views are desired.

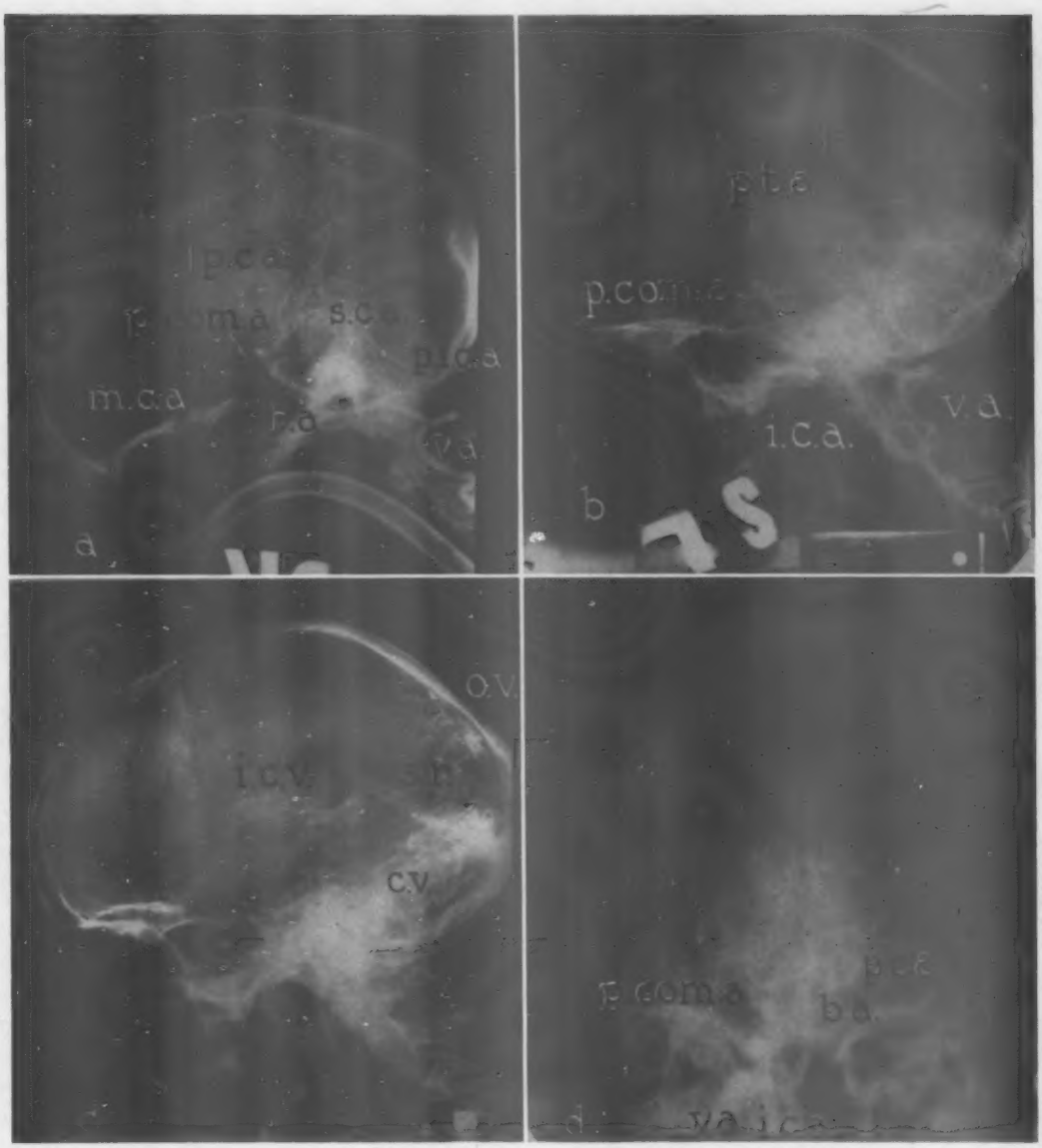


Fig. 1. Normal vertebral angiograms. (a) Normal vertebral arteriogram (lateral projection). (b) Normal vertebral arteriogram, with communication to the internal carotid artery. Note the needle point entering the vertebral artery. (c) Normal vertebral phlebogram. (d) Normal vertebral arteriogram (occipital view) showing, on left, communication with carotid system.

The following abbreviations are used for all the figures: *a*—aneurysm; *a.c.a.*—anterior cerebral artery; *b.a.*—basilar artery; *c.v.*—cerebellar veins; *i.c.a.*—internal carotid artery; *i.c.v.*—internal cerebral vein; *m.c.a.*—middle cerebral artery, *p.c.a.*—posterior cerebral artery, *p.c.v.*—posterior cerebral veins, *p. comm. a.*—posterior communicating artery; *p.i.c.a.*—posterior inferior cerebellar artery; *p.t.a.*—posterior thalamic arteries; *s.c.a.*—superior cerebellar artery; *s.r.*—sinus rectus; *v.a.*—vertebral artery.

(thalamogeniculate) and posteromedial (thalamoperforating) branches of the posterior cerebral artery. Occasionally, the posterior communicating artery and portions of the middle and anterior cerebral arteries may fill (Fig. 3b and 1a). Under circumstances as yet unclear, there is sometimes retrograde filling of an opposite vertebral artery (Fig. 5b); at other times there is filling of the internal carotid artery

(Fig. 6d) by reflux, apparently from the circle of Willis.

The venous return from the vertebral injection finds its way into the posterior cerebral cortical veins (which empty into the superior sagittal sinus) as well as into the internal cerebral vein and the straight sinus (Fig. 1c)

While a variety of other views of the vertebral-basilar system may be taken, the most valuable adjuncts to the routine lateral exposures appear to be the occipital and axial views. In the former (Fig. 1d) there is a somewhat blurred tree-like structure, showing filling of both posterior cerebral arteries and their branches in the cerebrum. The cephalad portion of the vertebral artery and the basilar artery can be seen, somewhat foreshortened. In this particular film, there arises from the left posterior cerebral artery a small short vessel passing downward to empty into a large artery which appears to pass further downward to cross the superimposed vertebral artery. These structures can also be seen in a lateral view (Fig. 1b) and almost certainly represent the posterior communicating and internal carotid arteries. The axial view (Fig. 6c) gives an excellent view of the basilar artery. The lateral pontine and other vessels which come off at right angles are not visible in this film. Occasionally, this view allows visualization of the reflux into the contralateral vertebral artery.

Figure 1b shows the tip of the needle in the vertebral artery and gives some idea of the angle of incidence.

The following case histories indicate some of the uses to which vertebral arteriography might be turned.

FIG 2. (a) Vertebral arteriogram showing thalamic metastasis (*m*). (b) Normal arteriogram showing the thalamic blood supply, for comparison with the vascularity of (a).

CASE 1. F. F. (Hosp. No. 107027), a white male laborer, aged forty-nine, was hospitalized because of occipital and frontal headaches, numbness and weakness of the left arm and difficulty in walking, all of two weeks' duration. He had been constipated for years and five months prior to hospitalization had had bloody stools for two or three days. Occasionally nausea was present during the development of his neurological symptoms.

Examination on August 28, 1946, revealed some dullness on percussion at the left lung base, musical wheezes at the left apex, and expiratory wheezes over the right upper lung. The abdomen appeared normal, and no peculiarities were found on rectal examination.

Neurological study showed dilatation of the right pupil, bilateral blurred disc margins, hemiparesis on the left with hyperactive tendon

reflexes, incoordination of arm and leg movements, and falling to the left in Romberg's position and in walking. There was a questionable Babinski sign on the left. Routine blood count, serology, chemistry and urinalysis were not revealing. Roentgenograms of the chest were reported as indicating an old healed tuberculosis with densities suggestive of metastatic malignancy.

On September 3, 1946, a right carotid angiogram was attempted. When the films were developed (Fig. 2a), it was seen that the cerebral circulation was injected by way of the vertebral artery. Most of the vessels of the posterior fossa are obscured. The anterior half of the basilar artery is seen, branching to give off the right superior cerebellar and posterior cerebral arteries. The posterior communicating artery is filled, and shadows of both anterior cerebral arteries are seen, one definitely anterior to the other. Arising from the region of the basilar termination is a single vessel passing upward to the region of the thalamus, where it breaks up into a circumscribed circular mass of minute blood vessels. On September 6, 1946, a right fronto-temporo-parietal bone flap was turned down revealing tense dura mater but with considerable fluid in the subarachnoid space. Then parietal and temporal areas were needled, but no tumor was encountered. A decompression was left, the temporal horn filled with air, and films taken later which showed shift of the third ventricle to the left, with the occipital horn on the right in good position. Postoperatively there was left hemiplegia. Roentgen therapy was begun on the sixth postoperative day, but the patient developed bronchopneumonia and died on September 17, 1946.

Autopsy revealed bronchopneumonia, old healed tuberculosis of the lungs, and carcinoma of the rectum with metastases to the regional nodes, cecum, spleen, kidney, adrenals, pancreas, stomach, lungs and brain. Sections through the brain showed metastases in the right frontal and parietal lobes, left cerebellar hemisphere, pons, and there was a metastasis (3 cm. in diameter) in the right thalamus, pushing the internal capsule to the right. This is undoubtedly the mass shown in the arteriogram in Figure 2a. Microscopic study showed adenocarcinoma.

Case II. W. H. was only five years old when he fell while holding an open knife, the blade entering his left lower lid. There was bleeding from the wound, and protrusion and edema of the orbital contents. Vision was not impaired. The swelling fluctuated intermittently, until at the age of eight he was struck again in the eye, causing an increase in swelling. This progressed during the next two years. He was examined at

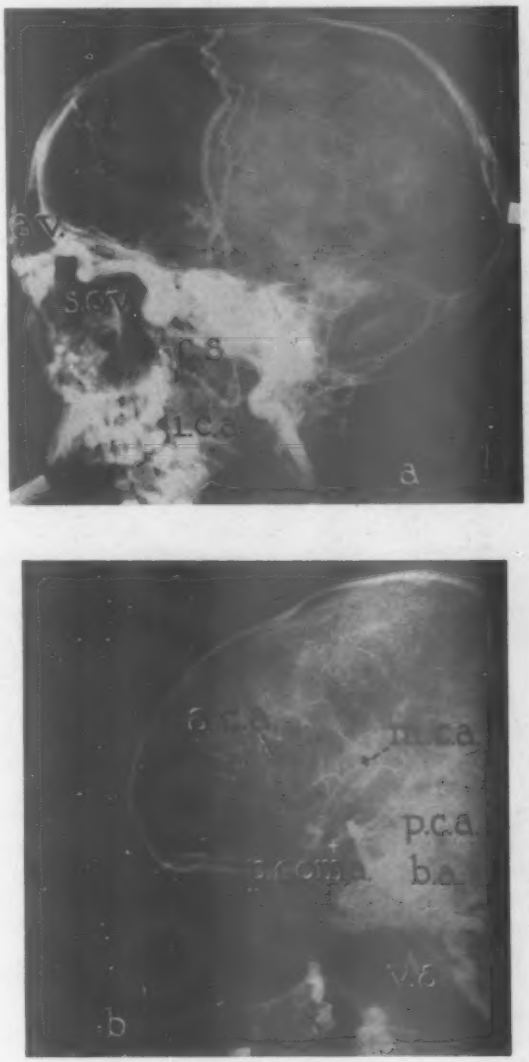


Fig. 3. Case II. Carotid-cavernous fistula. (a) Carotid arteriogram. *c.s.*—cavernous sinus; *s.o.v.*—superior ophthalmic vein; *a.v.*—angular vein. (b) Vertebral arteriogram.

the age of ten at the Illinois Eye and Ear Infirmary, where a diagnosis of pulsating exophthalmos was made. He was transferred to the Illinois Neuropsychiatric Institute (Hosp. No. 112177).

Examination of this ten year old colored boy showed protrusion of the contents of the left orbit with a pulsating mass in its superior portion. A bruit could be heard here. The left side of the forehead was crossed by tortuous dilated blood vessels, compression of which caused swelling of the left orbital contents. The angular vein was especially prominent. The conjunctiva of the left eye was engorged. Vision was 20/20 in each eye. Because it was impossible to tell which vessels were involved arteriography was suggested. On June 20, 1947, diodrast was injected into an artery in the neck in an attempt to do carotid angiography. Roentgenograms showed (Fig. 3b) filling of the vertebral and basilar system, with marked dilatation of the communicating vessels allowing filling of the anterior cerebral and middle cerebral arteries. Because of difficulty in finding the carotid artery, the boy was taken to the operating room where the carotid vessels were surgically exposed; he was then returned to the Roentgen Department where the common carotid artery was injected with diodrast. The films now taken showed (Fig. 3a) filling of the internal carotid artery as far as the sella turcica. Here the contrast medium is seen to pass into the cavernous sinus and the superior ophthalmic vein and out into the facial and angular veins to fill (ultimately) the superficial temporal and frontal veins. It was then clear that this was a classical traumatic carotid-cavernous fistula and that there was adequate circulation for the anterior half of the brain through the basilar system. On June 24, 1947, both the internal and the external carotid arteries on the left were again exposed and separately ligated, causing disappearance of the bruit, thrill and pulsation. The next day there was again some slight thrill and bruit over the eye, but this was no longer evident in the forehead. The boy was sent home on the eighth postoperative day. He was seen last on March 18, 1948. There was still a slight proptosis with mild bruit audible over the eye. This could be obliterated by compression of the right (contralateral) common carotid artery. There was no evidence of glaucoma and no visual disturbance. He had no pain and it was agreed that no further therapy was needed, at that time.

CASE III. S.Mc., a housewife, aged fifty-two, was a known diabetic for over a year. She was also known to have benign essential hypertension. Three weeks before hospitalization she began to vomit several times a day, had some difficulty in talking, was unable to walk, and gradually lost urinary sphincter control.

Examination on admission on March 20, 1948 (clinic No. 339047) revealed blood pressure of 160/110. The heart was enlarged to the left and electrocardiogram showed an abnormal tracing compatible with chronic cardiac disease. Other than an arteriovenous ratio of 1:2 in the fundi, there were no signs of arteriosclerosis. There was mild nystagmus on lateral gaze. Hypalgesia of the cornea and face on the right and of the left side of the body below the face was present. Mild hemiparesis with spasticity was found on the right side, including a right central facial weakness. The tendon reflexes on the right were increased and the Hoffman's and Babinski's sign were present on the right. Spinal puncture revealed no abnormalities of pressure but the protein was slightly elevated to 50 mg. per cent. Because of the bilaterality of symptoms, arteriography was suggested.

On April 2, 1948, the right vertebral artery was injected percutaneously with diodrast and roentgenograms taken (Fig. 4). The vertebral and basilar arteries are quite narrow compared to normals (Fig. 1b and 2b), and the acute bends of the normal vessels are opened out. There are irregularities of diameter of the extracranial portion of the vertebral artery. The intracranial branches are sparse and the

FIG. 4. Case III. Vertebral-basilar arteriosclerosis. Note narrowed and irregular contours compared with those of Figures 1, 2b, 3b.

terminal vessels exceedingly tenuous. These findings are considered to be compatible with arteriosclerosis of the vertebral-basilar system.

During the next few weeks the hypalgesias diminished, the right hemiparesis grew less, a right Horner's syndrome appeared, only to disappear again by the time of discharge. The diagnosis at discharge was encephalopathy due to brainstem arteriosclerosis.

Case iv. E.B., a housewife, aged thirty-eight, had severe headaches and stiff neck following the birth of her second child five years before she was hospitalized. She was otherwise well until October 7, 1947, when she was found comatose and moaning in the bathroom. She was taken to another hospital where spinal fluid pressure was 400 mm. water and numerous red blood cells were found in the fluid. Punctures were repeated twice daily and she improved, talked, and her headaches diminished. She was transferred to the Illinois Neuropsychiatric Institute (clinic No. 334325) on October 22, 1947. There was some residual nuchal rigidity and there was weakness of the left lower face and left leg, with absence of abdominal reflexes on that side. There were Babinski's signs on both sides. She seemed to be somewhat dull and confused. Lumbar puncture pressure was 170 mm. of xanthochromic fluid with positive Pandy's test and no cells, and with 96 mg. per cent total protein. Skull and chest films and routine laboratory studies were normal. On October 25, right cerebral angiography was done by the percutaneous technique under pentothal anesthesia; no vascular anomaly was disclosed. On October 29, angiography of the left common carotid artery similarly proved to be normal. Two days later, while expelling a bowel movement, she had a seizure followed by Cheyne-Stokes respiration and coma. Lumbar puncture yielded bloody fluid at a pressure of over 600 mm. water. Fifteen cubic centimeters were removed slowly, reviving the patient, who began to cry with headache. Later, electroencephalography was done, showing diffuse irregular slowing in all leads, with some 4–7 per second activity in only the left hemisphere. In the ensuing days she became more lucid and complained less. On November 17, neurological study showed slight lower left facial weakness. Air conduction was not now better than bone conduction on the right, and Weber's test lateralized to the right. The left abdominal reflex was depressed. Aside from some confusion there were no other neurological signs. She began to become irrational. Because of the possibility that the bleeding might be from a tumor not previously visualized and because the angiograms showed upward curving of the callosal arteries, pneumoencephalography with helium was done under

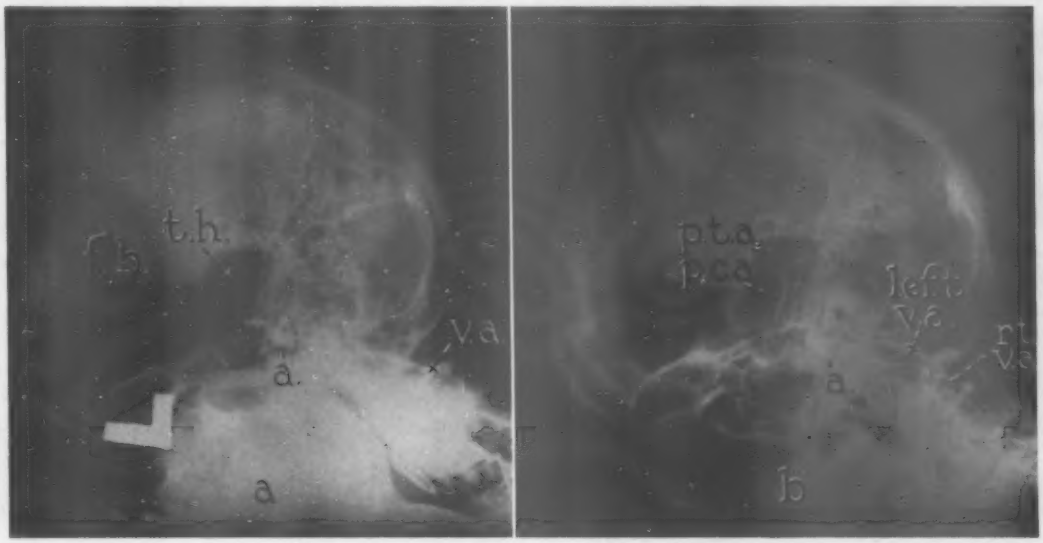


Fig. 5. Case iv. Basilar aneurysm (E.B.). (a) *f.h.*—frontal horn; *t.h.*—temporal horn. (b) Stereoscopic view, showing both vertebral arteries. The aneurysm is less clearly disclosed below the auditory meatus.

pentothal anesthesia. The films showed generalized dilatation of the ventricular system without filling of the subarachnoid spaces. She became more and more confused and had to be sedated with paraldehyde. On November 25, 1947, it was decided that vertebral angiography should be done. This was done, for the first time deliberately, by the percutaneous method. Stereoscopic films (Fig. 5a and 5b) show residual gas in the tips of the dilated anterior and temporal horns. Posterior to the dorsum sellae is seen a bilobed mass at the level of the acoustic meatus, continuous with the basilar artery both anteriorly and posteriorly. The posterior cerebral artery crosses the gas shadow in the temporal horn and above this can be seen the filagree of fine thalamic vessels. In Figure 5b both vertebral arteries can be seen, indicating reflux from the basilar artery. Stereoscopic visualization clearly indicates the dilatation is in a portion of the basilar artery. It was decided that this lesion would not be amenable to surgical attack.

In the fortnight which followed, she was irrational, incontinent, and had to be spoon fed. She gradually improved, could sit in a chair, became continent and more coherent, and was discharged on December 9, 1947. She was most recently seen in the out-patient clinic on May 13, 1948. She had been walking but with difficulty. She complained of mild headache and pain over the left eye. There was spasticity and increased reflexes on the left and some left lower facial palsy. Bilateral Babinski's signs persisted. She was eating well and seemed content.

CASE V. C.W., a white housewife, aged forty-one, was admitted to the Illinois Neuropsychiatric Institute (clinic No. 337105) for evaluation of intracranial pathology on January 26, 1948. Five years earlier, she had had a dizzy spell, had fallen, but was not unconscious. Strabismus was found. Lumbar puncture was reportedly normal. After two weeks she recovered and remained well for the next two years except for frequent headaches. She then had sudden onset of unconsciousness which lasted for six hours and lumbar puncture yielded bloody fluid. During the next thirteen weeks she had repeated episodes of unconsciousness, confusion, disorientation, with urinary incontinence and right-sided paralysis. She gradually regained the use of her sphincters and had sufficient recovery to be able to walk with assistance. Difficulty in speaking arose about this time but it also improved. Three months before admission the right-sided weakness returned with urinary incontinence and increase in speech difficulties. There were also frequent outbursts of crying.

Examination revealed a marked spastic hemiplegia with hyperactive tendon reflexes, Babinski's sign and absent abdominal reflexes on the right. The left lower extremity was also weak, with exaggerated deep reflexes, ankle clonus and Babinski's sign. There was bilateral tremor at rest. The left pupil was larger than the right but reacted well to light and in convergence. The extraocular muscle movements were normal. She was unable to speak when excited and was easily moved to tears or laughter, often inappropriately so. Blood counts, blood chemistry, serology, urinalysis and plain skull films were normal. Electroencephalogram showed a mildly slow record with no evidence of localized disorder in the accessible cortex. On January 29, 1948, a left carotid arteriogram was attempted, but fortunately the left vertebral artery was injected instead. This revealed (Fig. 6a) a huge aneurysm at the end of the basilar artery. The circulation appeared otherwise normal. Study of the stereoscopic arteriograms and of the phlebogram (Fig. 6b) failed to reveal the exact point of origin of the outpouching. It was felt that a carotid angiogram might shed some light on this. This was done by the percutaneous method on the left side on February 4, 1948. The intracranial circulation appears (Fig. 6d) normal except that the first portion of the left posterior cerebral artery and posterior communicating artery is pushed upward leaving a large clear space behind the sella turcica which corresponds well to the region of the aneurysm. The patient recovered readily from this procedure and was discharged on February 13, 1948, in care of her family.

In later reviewing this case it was felt that there was a remote possibility that the neck of the aneurym might be clipped. The patient was, therefore, readmitted on April 3, 1948. She lay in bed, unable to control her emotions and displayed pathological laughing and crying. There was dysarthria, right hemiparesis with increased tendon reflexes, clonus and Babinski's sign. There was increased tendon reflex activity in the left leg with clonus and Babinski's sign. Sensation was intact. The left pupil was larger than the right. Anteroposterior vertebral angiography had been requested to visualize more clearly the point of origin of the aneurysm. On

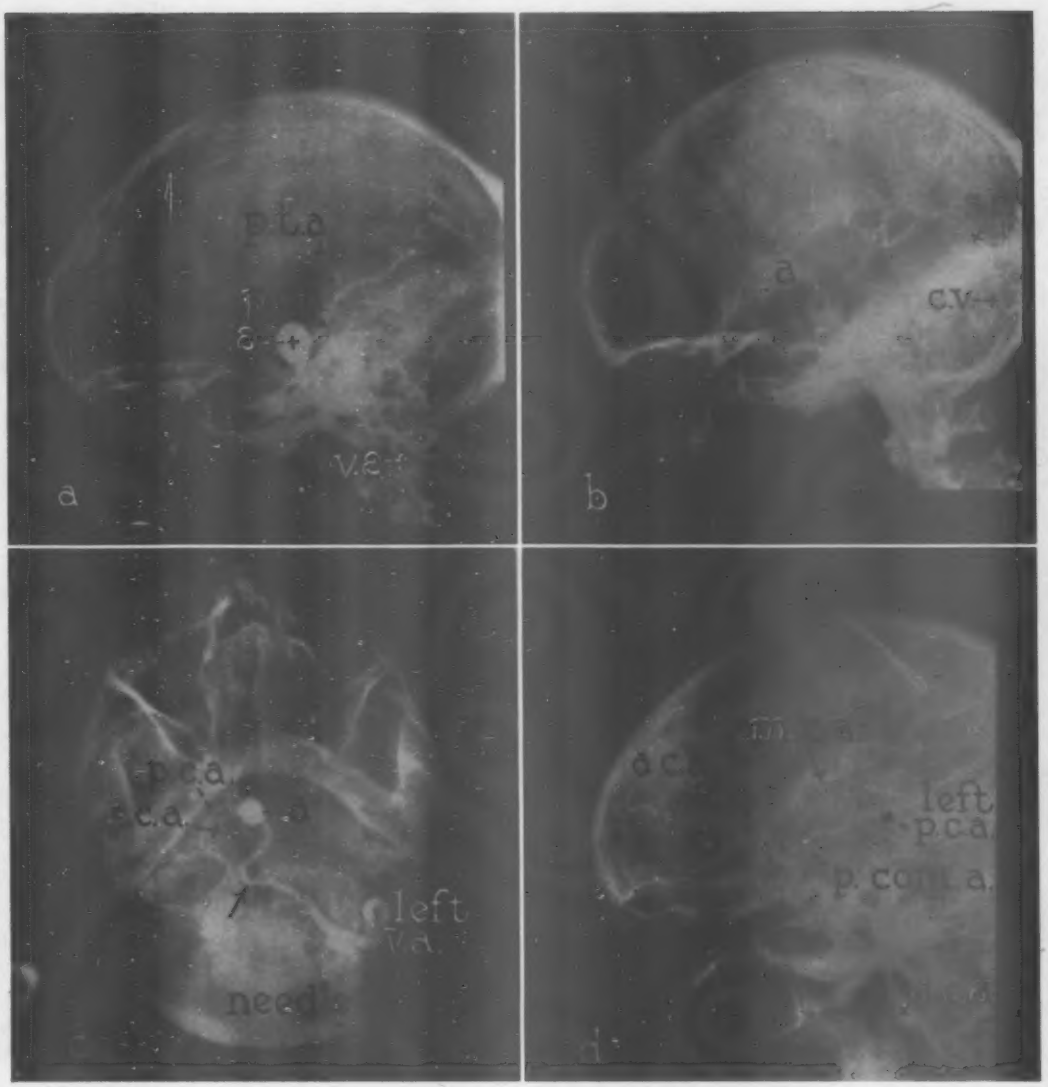


Fig. 6 Case v. Basilar aneurysm (C.W.). (a) Vertebral arteriogram (lateral view). (b) Phlebogram, with dye still in aneurysmal sac. (c) Vertebral arteriogram (axial view). The arrow marks the site of junction with the right vertebral artery, not shown in this film. (d) Carotid arteriogram (lateral view). Note pushing upward of first portion of left posterior cerebral and posterior communicating arteries.

April 10, 1948, the left vertebral artery was deliberately injected percutaneously with the patient's head lying on the plate holder in such a way that an axial view could be taken. To avoid excessive shadow, a plastic intratracheal tube was used instead of the conventional rubber tube. Because of the density of the basal structures, it was felt expedient to use thorotrast (12 cc.) for one, and diodrast for the other of the stereoscopic films. Both gave good contrast. Figure 6c shows the needle entering the left vertebral artery which is convoluted where it enters the skull. The basilar artery is of a reversed S-shape and at its terminus is the rounded aneurysm, from which arise the posterior cerebral and posterior cerebellar arteries of the right side. In the stereoscopic plate (which is not shown) the cephalad 2 cm. of the right vertebral artery is also filled, by reflex.

It was then apparent that there was little to be done in the way of therapy. The following morning the patient rather rapidly became cyanotic and restless but not confused, and was able to ask for water. The left pupil was more

dilated. The blood pressure gradually fell, the temperature rose and the pulse became weaker. Lumbar puncture revealed clear colorless fluid with 80 mm. fluid pressure, no cells, and negative Pandy's reaction. Rales developed in both lungs in spite of oxygen and chemotherapy and she died in the morning of April 13, 1948.

Autopsy revealed extensive bilateral bronchopneumonia. Gross examination of the brain

FIG. 7. Case v. Basilar aneurysm (C. W.). Photograph of base of brain at autopsy showing aneurysm.

revealed a firm rust-colored walnut-shaped mass about 3 cm. in diameter (Fig. 7). It lay anterior to and tended to compress the more cephalad portion of the pons, which in turn surrounded the posterior superior surface of the mass. Rostrally, the lesion extended to within 5 mm. of the pituitary stalk. The basilar artery entered slightly (2–3 mm.) to the right of the middle of the lesion. About 1 cm. to the right of this point of entry there was another artery which appeared to arise from the bulbous mass and immediately divided into the posterior cerebral and anterior superior cerebellar arteries. Also arising at this point was a thin band of tissue which traversed the right side and anterior aspect of the mass to reach the posterior communicating artery on the left, about 1 cm. posterior to the origin of the left optic tract. A probe passed up the basilar artery entered the terminal mass. The entire region has been kept as a gross museum specimen, so sections are not available.

DISCUSSION

Although Egas Moniz[19] introduced carotid angiography in 1927, he was loath to inject the vertebral arteries because of the physiological importance of the medulla oblongata and because of the difficulty in exposing the vertebral artery. When, in 1933,[20,21] he compiled data from 600 arteriograms in his files, he noted 5 cases in which the basilar, posterior cerebral, and even cerebellar arteries were filled. Moniz thought this occurred by retrograde filling down the carotid into the subclavian and vertebral arteries. In none of the figures presented in his monograph of 1940[19] is the cervical portion of the vertebral artery seen, although the basilar and carotid systems are well filled. It seems much more probable that the flow was through the posterior communicating vessels (see also Fig. 1b). None of these patients was injured by the procedure, so it was felt safe to investigate the posterior fossa deliberately. Direct vertebral exposure and injection appeared to be too difficult and uncertain, so Moniz, Pinto and Alves[21] introduced the technique of retrograde injection into the subclavian artery. This vessel was exposed by incision parallel to and above the clavicle. Injection of 14 cc. thorotrast was made against the flow after temporary occlusion of the peripheral part of the vessel. This allowed visualization of the carotid and vertebral vessels on the right, and of the vertebral on the left. His figure 87 (1940)[19] shows upward displacement of the superior cerebellar and posterior cerebral arteries by a posterior fossa tumor.*

Olivecrona (1935)[22] succeeded in injecting the exposed vertebral artery directly. Berczeller and Kugler[1] described a technique based on cadaver dissection, with injection of the vertebral artery as it passes

* This is the same figure as is shown in the articles in 1933[20,21] with Pinto and Alves. The displacement is not marked in the reproductions and is not as impressive as that of Shimidzu's case.[27]

from the transverse process of the atlas. They suggested that the artery could be injected at this locus at the time of suboccipital exploration; films taken in the operating room could then be used for orientation of the operator.* Unfortunately, no clinical examples are given, nor is there evidence that this operative approach was used in a living patient.

Shimidzu (1937)[27] was successful in injecting the subclavian artery percutaneously in a modification of Moniz's idea of retrograde filling of the vertebral artery.† Sjöqvist[28] was dissatisfied with the results of retrograde filling, but with direct exposure of the vertebral artery at its entry into the transverse process of C_6 he had better success. In each of 8 instances, 10 cc. of thorotrast were injected, with good filling in 6 cases. Three of these were normal. One showed displacement of the basilar artery in a case of cerebellopontine angle tumor. This could not be considered diagnostic, however, for in another case of similar displacement operation failed to disclose a tumor and it was concluded that the marked curvature might well be an anatomical variation. In the last case, ventriculogram indicated tumor of the fourth ventricle in a seven year old boy. At operation no tumor was seen, but a vessel between the tonsils was interpreted as a vascular malformation. An arteriogram appeared to confirm this and the vertebral artery was tied off in the neck. Symptoms recurred and reoperation revealed medulloblastoma. Eventual autopsy disclosed no signs of vascular malformation.

In 1940, Takahashi[29] described a percutaneous technique for vertebral injection, apparently done under local anesthesia. A horizontal line was drawn 4 cm. below the thyroid incisura. Where the carotid pulsation crossed this line was taken as a point overlying the vertebral artery. A line was drawn from here to a point on the clavicle 2 cm. lateral to its inner end, and this line was taken as the line of the vertebral artery. A needle attached to a syringe was inserted over this line and, at a depth of 3.5–4.5 cm. the artery could be encountered and recognized by blood pushing into the syringe. Four to 5 cc. of thorotrast were injected and lateral or anteroposterior films taken immediately. This procedure was felt to be without danger, although more difficult than percutaneous carotid arteriography. Irritation of the vagus to cause vomiting is the only complication mentioned. A vertebral arteriogram is shown which has filling of the entire intracranial circulation in a woman, aged twenty-eight, with complete occlusion of the common carotid arteries from thromboangiitis obliterans (proved by biopsy and autopsy findings.)

This percutaneous technique was thought by Krayenbühl (1941)[12] to be too complicated and uncertain, so he used Moniz's open subclavian retrograde technique. A case of aneurysm at the junction of the posterior cerebral and posterior communicating vessels is described, and the arteriogram shown. In this case, carotid angiography had failed to disclose the vascular abnormality responsible for left oculomotor palsy and subarachnoid hemorrhage in a forty-five year old man.

The first reported instance of vertebral angiography in the United States is that of King (1942),[11] who injected 10 cc. of thorotrast into the exposed vertebral artery, using a right-angled needle. The patient, aged forty, had subarachnoid bleeding complicating central nervous system syphilis. A bulbous end was thought to be disclosed at the cephalad tip of the basilar artery, and it was speculated that this might be an aneurysm (actually it is a normal configuration; see Figure 2b for a comparable finding).

* This has been done successfully by Dr. A. Ecker of Syracuse (personal communication).

† The needle was inserted through the omoclavicular trigone towards the palpable pulsation of the subclavian. The injection of 7–8 cc. of thorotrast was made after an assistant occluded the axillary artery in the axilla. Figures are shown of increased vascularity having its origin in a superior cerebellar artery in a thirty year old male with a meningothelioma under the right tentorium and of pushing upwards of the posterior cerebral artery and basilar artery tip by a pontine tumor in a nineteen year old male. In both of these autopsy confirmed the vascular changes in the tumor.

The long dearth of reports during World War II ended with that of List, Burge and Hodges in 1945.[15] They used Moniz's technique for vertebral visualization in 6 patients during the three year period covered by their paper. Tracings of the vessels are shown, but no reproductions of films or cases reported. List (1946)[14] was dubious about percutaneous vertebral angiography because of the small size and deep position of the vessel. In the discussion of this paper, Freeman[7] mentioned visualization of the vertebral circulation by injections made through skin puncture.*

Lowman and Doff[16] still considered (1945) open techniques the only possible means for introduction of contrast medium into the vertebral-basilar system. Poppen (1948)[21] used the Moniz technique for vertebral angiography but mentioned percutaneous injection into the subclavian artery when this arched high above the clavicle.

Radner† has described a technique in which a rubber catheter is inserted into the radial artery and moved under fluoroscopic control until the tip is opposite the opening of the vertebral artery. Diodrast is then injected to obtain a vertebral angiogram. This entails sacrifice of the radial artery, but this is considered of little consequence in view of the rich collateral circulation at the elbow.

It appears to us that the percutaneous technique described above is simpler and less liable to error than that of Takahashi. It offers the usual advantages of a percutaneous technique—lack of operative procedure, ease of repetition, less total time consumed, as well as the usual disadvantages of a "blind" injection—extravasations of contrast medium, invisible hemorrhages, difficulty in finding the vessel. Even the open methods are not always productive of good end results (Sjöqvist). In experienced hands by the percutaneous method the probability of obtaining good visualization is high. We have not attempted to make these injections under local anesthesia, although this could be done after infiltration of the regions involved, just as percutaneous carotid arteriograms have been done. The experience is doubtless a distressing one and, in the past, we have found it preferable to do carotid angiograms under general anesthesia (after having tried them under local anesthesia as well).

In the more than 20 successive deliberate vertebral angiograms done here, failure to fill the vertebral artery has occurred only twice. In each of these early attempts, the failure was due to lack of appreciation of the venous character of the blood entering the observation tube. It did not rush back into the tube and had to be aspirated. In each case injections were made and films exposed. In each, the vertebral veins and their cervical tributaries are seen. Since then, injections have not been made until bright red blood with good pressure has pushed its way into the syringe-needle system.

There have been two instances of urticarial reaction to diodrast following the injections, in spite of absence of reaction to an intravenous test dose of 5 cc. These responding readily to ephedrine sulfate. Extravasation of diodrast due to improper placement of the needle or movement of the patient has occurred. This has caused no great difficulty and later roentgenograms show the dye is soon taken up from the extravascular tissues. There have been no hemorrhages or hematomas recognized, although these might well be present and not disclose themselves.

One patient subjected to vertebral angiography as a part of a complete diagnostic survey for intractable headache, developed a brachial plexus root neuralgia. During the needling for the artery in this early case, the needle was passed lateral to the transverse process in attempting to find its tip; it was also passed caudally from its locus on the bone in attempting to find the artery below the transverse process. In so manipulating the needle, it was obvious that a

* He states (1938, personal communication) that these were not deliberate vertebral injections.

† Radner, S. Intracranial angiography via the vertebral artery. Preliminary report of a new technique. *Acta radiol.*, 1947, *38*, 838–842.

nerve root had been struck, for there was twitching of the deltoid muscle. The complaints of the patient postoperatively seem to be out of proportion to the trauma and it is possible that a large psychogenic factor is exaggerating the neuropathy. Since this time, however, it is considered unwise to direct the needle caudally in trying for the vertebral artery. Actually we have found it is more difficult to inject the artery low in the neck and our best and easiest injections have been made above the fifth cervical transverse process. By always passing the needle in a cephalad direction, one is less likely to strike the cervical nerve roots which are given some protection by the superior anterior ledge of the transverse process.

It is theoretically possible to enter the intervertebral foramen by directing the needle point sufficiently medially. This might engage the spinal nerve, the root sleeve, or even enter the spinal canal. This is avoided by proper direction of the needle tip.

It is also possible theoretically to produce a traumatic arteriovenous fistula in the vertebral canal by puncturing both vessels. There is no evidence that this has occurred in any of these patients. In the presence of normal clotting mechanisms and with a sharp needle, the holes in the artery and vein (if both be injured) should close over quickly (especially since the direction of the puncture into the artery favors automatic closure by pressure from within).

One as yet unexplained complication has recently been encountered. It brings to mind the occasional instance of hemiparesis which may follow carotid angiography.

Case vi. B.R., a farmer, aged forty-one, had severe frontal headaches for a week, starting December 24, 1947. These receded with treatment for sinusitis, but on January 1, 1948, he had an intense frontal headache, blurring of vision, and a major seizure followed. He was unconscious and incontinent three hours later and removed to a hospital the next day. Here lumbar puncture revealed bloody fluid. He was irrational for several days but had no focal signs. Within three weeks he gradually recovered and was sent home. Here he soon regained his former strength but had such a mental depression that he was sent to the Illinois Neuropsychiatric Institute (clinic No. 340839).

He was admitted for arteriography, which was initiated two days after admission (after routine examinations and laboratory studies revealed no abnormalities). A right carotid arteriogram on May 7, 1948, failed to reveal any aneurysm. On May 12, a left common carotid and a left vertebral arteriogram were done without difficulty; they also failed to disclose an aneurysm or other vascular malformation. When he awakened from the anesthetic the next morning it was noticed that he had weakness (but not paralysis) of the left side of the body, diminished ability to perceive pinprick on the right half of the body below the neck and urinary retention. Lumbar puncture two days later yielded clear colorless fluid under normal pressure and with only 39 mg. per cent total protein. No red blood cells were seen. Over the course of the next few weeks the tidal drainage which had been instituted for the overflow incontinence was removed, strength began to return in the arm and leg, and the patient was able to be up, first with a cane and later without. He still had some unsteadiness in walking when he was discharged on June 20, 1948, to be allowed to continue convalescence at home.

Reviewing the technique of angiography in this case, we are certain that there was no maldirection of the needle into the spinal canal; no spinal fluid was obtained at any time, no blood was found in the spinal fluid, and there had been no unusual difficulties in finding the vertebral artery. The cause of the original subarachnoid hemorrhage has not been disclosed, nor can we ascribe a credible reason for the receding Brown-Sequard syndrome. That the vertebral angiography seems to be at the bottom of this appears to be certain, however, since the supposed site of the lesion is below the pyramidal decussation on the side of the angiography.

Visualization of the vessels of the posterior fossa has been considered of varying desirability by different authors. Sjöqvist (1938)[28] felt it was indicated for vascular malformations and vascular tumors. He thought it less useful than clinical examination and ventriculography for accurate

location of tumors of the posterior fossa. Moniz (1940)[19] was uncertain about its value, and thought it much less important than carotid angiography. He believed it useful for localization of cerebellopontine angle neoplasms (by lateral displacement of the basilar artery in anteroposterior views) and for angiomas and aneurysms of the posterior fossa. He found the vascular pattern of the tumors only rarely shown by vertebral arteriograms. Krayenbühl (1941)[12] felt that arteriography was valuable mostly for diagnosis of aneurysm and arteriovenous malformations. List (1946)[14] stated, "The diagnostic results of vertebral arteriography, however, are comparatively meager in comparison to the effort one makes to show the vessel." On the other hand, Shimidzu (1937)[27] remarked, "Bei schwerdifferenzierbaren Tumoren der Hinterschädelgrube ist die Arteriographie der A. vertebralis unentbehrlich. Es hilft vor allem zur Seitendiagnose, die für Operation wertvoll ist."* One gathers the impression that the value of this type of angiography rises with ease of performance and wide application in more cases.

Actually, the major use to which vertebral angiography has been put in our experience has been in the discovery of vascular lesions of the posterior fossa.

Aneurysms of the vertebral and basilar arteries have been known even before Cruveilhier (1835)[3] pictured a saccular aneurysm of the right vertebral artery. McDonald and Korb[17] refer to aneurysms of the posterior communicating arteries described by Morgagni in 1769 and to basilar artery aneurysms described by Blackall in 1814 and Hodgson in 1815. There have been several comprehensive reviews of intracranial aneurysm (McDonald and Korb, 1939[17]; Richardson and Hyland, 1941[25]) and isolated reports since then. Krayenbühl[12] described 2 aneurysms of the basilar artery and one of the left superior cerebellar artery disclosed at autopsy. These are in addition to the one disclosed by vertebral angiography to be at the junction of the posterior communicating and posterior cerebral arteries. Mitchell and Angrist[18] found 8 aneurysms of the posterior circulation (3 basilar, 2 vertebral, 1 posterior communicating, 1 posterior cerebral, 1 anterior inferior cerebellar artery) among 36 aneurysms found in 3,080 autopsies. Hoge (1943)[10] describes the case history and autopsy findings in an unruptured fusiform aneurysm of the basilar artery, due to arteriosclerosis. A rare fusiform aneurysm of the left posterior inferior cerebellar artery due to rheumatic disease is detailed by Lindsay (1944).[13] In Yaskin and Alpers' case (1944),[31] a large aneurysm of the left vertebral artery had compressed the cerebellum and brainstem, simulating a posterior fossa tumor. Dimitri and Aranovich (1944)[5] reported a rare aneurysm of the right superior cerebellar artery, ascribed to trauma.

Fattovich* discussed at some length the difficulty in diagnosis of one massive and one tiny aneurysm of the posterior communicating artery: the first occurred in a woman thought to have a basal tumor, and the other in a woman of sixty-one who appeared to have had an ordinary cerebrovascular accident. In neither of the 2 cases of aneurysm of the vertebral artery described by Rigdon and Allen† were there antemortem indications that the subarachnoid hemorrhage came from a vessel in the posterior fossa. From the pictures of the specimens, it appears that one, at least, might have been successfully attacked surgically.

In Dandy's[4] monograph of intracranial arterial aneurysms, 23 of 133 aneurysms are described as occurring on the posterior cerebral, basilar and vertebral arteries. Eleven of the basilar-vertebral group of 21 were discovered at operation; the rest, at autopsy. Poppen (1948)[24] states that 25 per cent of intracranial aneurysms occur in the posterior third of the circle of Willis and its

* "Arteriography of the A. vertebralis is indispensable in posterior fossa tumors which are difficult to differentiate. Above all it is a help in lateralization, which is valuable for operation."

* Fattovich, G. Contributo allo studio degli aneurismi intracranici. *Note e Riviste di Psychiat.*, 1940, *69*, 433–4621.

† Rigdon, R. H., and Allen, C., Jr. Aneurysms of the vertebral arteries; a consideration of their etiology. *J. Lab. & Clin. Med.*, 1944, *29*, 28–36.

vertebral flow. One patient with basilar aneurysm whom he reports had cranial nerve signs and typical glossopharyngeal tic. Two others in his series had vertebral aneurysms. Six of 46 autopsy confirmed aneurysms in Hamby's (1948)[9] series were on the basilar segment of the circle of Willis (posterior communicating, posterior cerebral, posterior inferior cerebellar and basilar arteries). Schwartz (1948)[26] has reported what appears to be the first arterial aneurysm in the posterior fossa successfully treated by direct attack. The vessel concerned was an unnamed anomalous one. It may represent a remnant of the primitive basilar-vertebral anastomosis or of the originally paired basilar artery group (Padget, 1945).[23]

Elkin and Harris (1946)[6] have reviewed arteriovenous aneurysms of the vertebral vessels in the neck, whose diagnosis, they feel, to be the most difficult of all such fistulae.

Diagnosis of these types of vascular anomalies is certainly more accessible with vertebral angiography, as shown by the 2 instances of basilar aneurysm described before. We cannot now agree with Yaskin and Alpers[31] that "The exact diagnosis of an unruptured aneurysm of the vertebral artery during life is no more possible today than it was when Gull stated, nearly eighty-five years ago, that 'Although we may from the circumstances sometimes suspect the presence of aneurysm within the cranium, we have at least no symptoms upon which to ground more than a possible diagnosis.'"

It seems probable that with wider use of vertebral angiography its field of application will become broader. It seemingly would be indicated in those patients in whom air study fails to visualize the posterior part of the third ventricle, the aqueduct of Sylvius and the fourth ventricle. It would be even more useful perhaps in those in whom clinically indicated posterior fossa exploration fails to reveal a cause for the patient's signs and symptoms. This holds especially for those with seizures who have otherwise signs and symptoms of posterior fossa neoplasm and in whom the lesion may well be at the tentorium. Alternatively, it may come to be preferred over air injections as a first diagnostic aid even though (at least in our hands) a general anesthetic is required. Angiography of either carotid or vertebral vessels seems to be readily tolerated in patients with marked increased intracranial pressure and does not carry with it the dangers of disturbing the ventricular equilibrium such as occurs in ventriculography; nor is it necessary to follow angiography with exploration. Whether or not vertebral angiography will permit differential diagnosis of tumor type as well as localization (as is true of many carotid visualizations) remains to be seen. The possible differentiation of meningiomas of the posterior fossa and other cerebellopontine angle tumors by angiography has already been mentioned by Campbell and Whitfield (1948)[2]; certainly it is best to be forewarned of tumor vascularity before planning an operation. Properly timed angiograms could show the chief side of venous outflow from the superior saggittal sinus, of importance in planning a combined supra- and infratentorial attack on cerebellopontine angle and tentorial tumors. Finally, the vexatious differentiation between pontine tumors and encephalitis, demyelinizing disease and primary vascular disease may well be advanced by wider application of this technique.*

SUMMARY

1. A new percutaneous technique for vertebral angiography is described. It has been used in over twenty patients with good visualization in all but two early attempts.

2. The normal vertebral-basilar angiograms are described.

3. Five case reports are given with reproductions of vertebral angiograms showing the type of information which can be obtained. Two of these are cases of basilar aneurysms pictured for the first time ante-

* We wish to thank Dr. Percival Bailey for his guidance and suggestions. Miss Roxanne Pickering, our X-ray technician has been most cooperative with technical details. The photographs are the work of Mr. Willard Huntzinger.

mortem without operation. One shows collateral circulation of the entire cerebrum in a patient with traumatic carotid-cavernous fistula. One concerns a thalamic carcinomatous metastasis, and one describes a patient with posterior fossa arteriosclerosis.

4. The historical development of vertebral angiography is reviewed.

5. A survey is made of the recent publications on aneurysms of the posterior intracranial circulation.

6. The indications and complications of vertebral angiography are discussed.

Neuropsychiatric Institute
912 S. Wood St.
Chicago 12, Ill.

REFERENCES

1. BERCZELLER, A., and KUGLER, H. Freilegung der Arteria vertebralis am Sulcus atlantis. Beitrag zur Arteriographie des Stromgebietes der Arteria vertebralis-basilaris. *Arch. f. klin. Chir.*, 1937, *190*, 810–815.
2. CAMPBELL, E., and WHITFIELD, R. D. Posterior fossa meningiomas. *J. Neurosurg.*, 1948, *5*, 131–153.
3. CRUVEILHIER, J. Anatomie pathologique du corps humain. Tom. II. J. B. Ballière, Paris, 1835–1842.
4. DANDY, W. E. Intracranial Arterial Aneurysms. Comstock Publishing Co., Ithaca, N. Y., 1944.
5. DIMITRI, V., and ARANOVICH, J. Sindrome cerebeloso, amiostático y sensitivo alterno por aneurisma protuberancial. *Rev. neurol. de Buenos Aires*, 1944, *9*, 295–316.
6. ELKIN, D. C., and HARRIS, M. N. Arteriovenous aneurysm of the vertebral vessels. *Ann. Surg.*, 1946, *124*, 934–951.
7. FREEMAN, W. In discussion following List.[14]
8. GREEN, J. R., and ARANA, R. Cerebral angiography; a clinical evaluation based on 107 cases. AM. J. ROENTGENOL. & RAD. THERAPY, 1948, *59*, 617–650.
9. HAMBY, W. B., Spontaneous subarachnoid hemorrhage of aneurysmal origin; factors influencing prognosis. *J.A.M.A.*, 1948, *136*, 522–528.
10. HOGE, S. F. Unruptured aneurysm of the basilar artery. *Arch. Path.*, 1944, *37*, 219–221.
11. KING, A. B. Demonstration of the basilar artery and its branches with thorotrast. *Bull. Johns Hopkins Hosp.*, 1942, *70*, 81–89.
12. KRAYENBÜHL, H. Das Hirnaneurysma. *Schweiz. Arch. f. Neurol. u. Psychiat.*, 1941, *47*, 155–236.
13. LINDSAY, S. Subarachnoid hemorrhage due to intracranial rheumatic aneurysm. *J. Nerv. & Ment. Dis.*, 1944, *99*, 717–726.
14. LIST, C. F. The differential diagnosis of expanding intracranial lesions by cerebral angiography. *Tr. Am. Neurol. Assoc.*, 1946, pp. 63–66.
15. LIST, C. F., BURGE, C. H., and HODGES, F. J. Intracranial angiography. *Radiology*, 1945, *45*, 1–14.
16. LOWMAN, R. M., and DOFF, S. D. Arteriography for the demonstration of intracranial aneurysms. AM. J. ROENTGENOL. & RAD. THERAPY, 1945, *53*, 341–347.
17. MCDONALD, C. A., and KORB, M. Intracranial aneurysms. *Arch. Neurol. & Psychiat.*, 1939, *42*, 298–328.
18. MITCHELL, N., and ANGRIST, A. Intracranial aneurysms—a report of 36 cases. *Ann. Int. Med.*, 1943, *19*, 909–923.
19. MONIZ, E. Die Cerebrale Arteriographie und Phlebographie. Ergänzungsserie zum "Handbuch der Neurologie," II. Berlin, J. Springer, 1940, viii, 413 pp.
20. MONIZ, E., and ALVES, A. L'importance diagnostique de l'artériographie de la fosse postérieure. *Rev. neurol.*, 1933, *2*, 91–96.
21. MONIZ, E., PINTO, A., and ALVES, A. Artériographie du cervelet et des autres organes de la fosse postérieure. *Bull. Acad. de méd., Paris*, 1933, *109*, 758–760.
22. OLIVECRONA, H. (1935) referred to by Berczeller and Kugler.[1]
23. PADGET, D. H. The circle of Willis: Its embryology and anatomy. Chap. III in Dandy.[4]
24. POPPEN, J. L. Diagnosis of intracranial aneurysms. *Am. J. Surg.*, 1948, *75*, 178–186.
25. RICHARDSON, J. C., and HYLAND, H. H. Intracranial aneurysms; clinical and pathological study of subarachnoid and intracerebral haemorrhage caused by berry aneurysms. *Medicine*, 1941, *20*, 1–83.
26. SCHWARTZ, H. G. Arterial aneurysm of the posterior fossa. *J. Neurosurg.*, 1948, *5*, 312–316.
27. SHIMIDZU, K. Beiträge zur Arteriographie des Gehirns—einfache percutane Methode. *Arch. f. klin. Chir.*, 1937, *188*, 295–316.
28. SJÖQVIST, O. Arteriographisch Darstellung der Gefässe der hinteren Schädelgrube. *Chirurg*, 1938, *10*, 377–380.
29. TAKAHASHI, K. Die percutane Arteriographie der Arteria vertebralis und ihrer Versorgungsgebiete. *Arch. f. Psychiat.*, 1940, *111*, 373–379.
30. TEPLINSKI, L., HARRIS, Z., CASSELS, W. H., and SUGAR, O. Anesthesia for neurosurgery. Anesthesiol., 1949 (in press).
31. YASKIN, H. E., and ALPERS, B. J. Aneurysm of the vertebral artery; report of a case in which the aneurysm simulated a tumor of the posterior fossa. *Arch. Neurol. & Psychiat.*, 1944, *51*, 271–281.

Vol. 61, No. 2

THE DETECTION OF GASTRIC CARCINOMA BY PHOTOFLUOROGRAPHIC METHODS*†

PART I. INTRODUCTION

By JOHN F. ROACH, ROBERT D. SLOAN, *and* RUSSELL H. MORGAN

BALTIMORE, MARYLAND

A PERUSAL of morbidity and mortality statistics reveals that the incidence of cancer of the digestive system is distressingly high. Approximately 60,000 men and 42,000 women above the age of forty develop gastrointestinal malignancy each year in the United States. Of these, almost 60 per cent die within one year of the time that the diagnosis is made. Moreover, those individuals who do not survive the disease comprise nearly one-half of the deaths resulting from all types of cancer and 5 per cent of the deaths occurring from any cause. Thus it is clear that cancer of the digestive system constitutes one of the serious problems confronting the medical profession today.

Of the various types of neoplastic disease occurring within the alimentary tract, cancer of the stomach is the most prevalent. In men, nearly 40 per cent of the malignant lesions arising in the digestive system are gastric in origin. In women, 30 per cent of such lesions lie within the stomach. The course which gastric cancer pursues is one of relatively short duration. It may be calculated from statistical data recently published by Dorn[1] that the average length of life following the recognition of the disease is of the order of one year and eight months regardless of therapy. It is therefore evident that the methods currently employed in the diagnosis and treatment of cancer of the stomach are, in general, ineffective.

The therapeutic procedures used in the control of gastric cancer have been radiological and surgical. Radiation therapy has been uniformly unsuccessful because of the high resistance that gastric neoplasms exhibit toward any of the radiations which have been available to this time. The record of surgical treatment also has not been satisfactory. Indeed the average five year survival rate of patients having cancer of the stomach lies in the neighborhood of 5 per cent even when optimum surgical methods are employed. The causes of such a low rate have recently been analyzed by Pack[2] who believes that the following four principal factors are responsible: (*a*) the patient is *inoperable* when the diagnosis of the disease is first established; that is, the lesion is so extensive that all operative procedures are precluded; (*b*) the patient is regarded as operable but when the abdomen is opened the lesion is found to be *unresectable;* (*c*) the patient has a resectable lesion but *dies during or shortly after operation;* and (*d*) the patient survives operation but dies from a *recurrence* of the disease or from other causes during the five year period following operation.

At present, Pack has found that approximately 50 per cent of patients who have gastric cancer are inoperable when the disease is first diagnosed. Of the remainder, almost one-half present unresectable lesions. Thus only 25 per cent of persons with gastric malignancy have any change of benefit from surgical intervention. Of these, one-third do not survive operation and of those who do recover[1] over two-thirds die from recurrent disease or from other cause within a few years. Thus the average five year survival rate for patients with gastric cancer reduces to 5 per cent.

The data presented by Pack are admittedly discouraging. A number of statistical

* From the Department of Radiology, The Johns Hopkins University and Hospital.

† This investigation was supported by a research grant from the National Cancer Institute, of the National Institute of Health, United States Public Health Service.

investigators, however, including Berkson,[3] have found that if a patient with carcinoma of the stomach is resectable and lives for a period of five years following operation, his life expectancy approaches that of individuals free of gastric malignancy. This is graphically illustrated in Figure 1 where the percentage of patients living after gastric resection is plotted as a function of the time following operation (curve B). that even if a patient has a resectable lesion, his chances of avoiding recurrence of the disease and subsequent death under present conditions are only 35 per cent; that is, two-thirds of patients with so-called resectable lesions are beyond surgical cure at the time of operation due to uncontrollable extension of the neoplastic process.

From the findings of Pack and of Berkson it is clear that the poor prognosis and

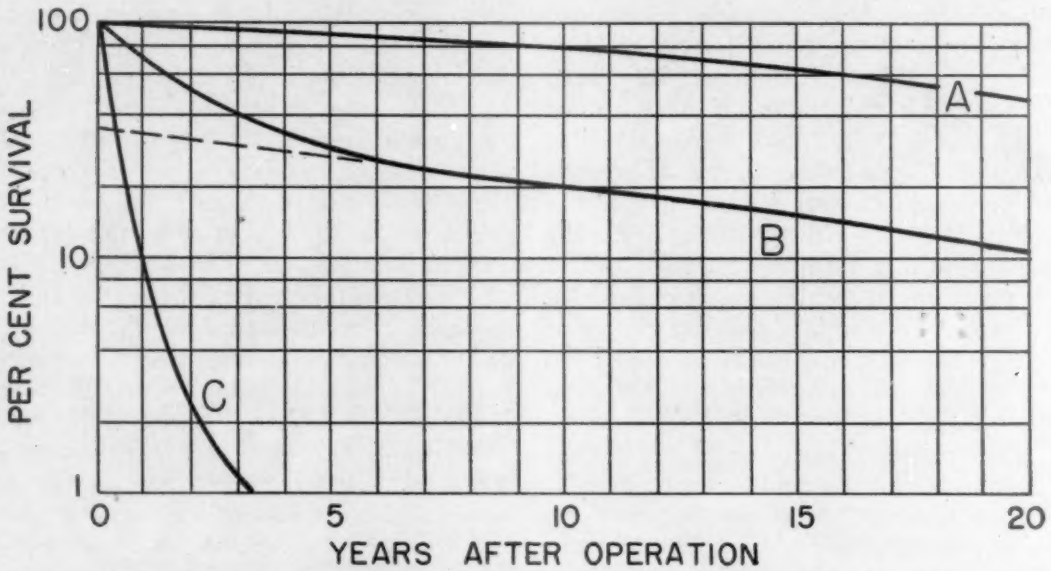


FIG. 1. Survival data for patients with gastric carcinoma. Curve A: normal population; curve B: patients with resectable lesions; curve C: patients with unresectable lesions (after Berkson[3]).

Also included are curves indicating the survival rates of persons in the normal population (curve A) and of persons with unresectable gastric neoplasms (curve C). It will be observed that after five years elapse, the rate of decline of the resection curve is closely similar to that of the normal population curve.

It is evident from the data presented in Figure 1 that surgery has much to offer the patient with gastric cancer. It must be emphasized, however, that the surgical intervention must occur early in the development of the disease process for it will be seen that if the straight-line portion of the resection curve is extrapolated to the left, it intercepts the zero-time axis at a survival value of 35 per cent. This indicates low survival rate of patients with gastric malignancy are due (*a*) to the advanced state of the disease at the time of its diagnosis and (*b*) to the dangers of surgical operation. The latter of these factors can undoubtedly be reduced to insignificance by improvements in preoperative and postoperative care and by advances in surgical and anesthetic techniques. The nullification of the first factor, however, constitutes a more difficult problem and requires that gastric cancer be diagnosed at an appreciably earlier time than is now possible. It has been thought by some that earlier diagnosis might be achieved by a nationwide educational program to inform layman and physician alike of the cancer problem. It is unlikely, however, that such

a program alone will materially affect the cancer death rate. This fact has been strikingly pointed out by Wangensteen[4] who cites the cases of several prominent physicians who were thoroughly conscious of the cancer problem, yet were unable to recognize their own symptoms and subsequently died of carcinoma of the stomach.

Fundamentally, the early diagnosis of gastric malignancy is a problem of finding those asymptomatic individuals in the general population who have the disease. Attention should therefore be directed toward the development of diagnostic procedures whereby large segments of the general population may be examined quickly and easily, at regular intervals, for gastric lesions. At the present time, the roentgenological method probably constitutes the most reliable diagnostic procedure at our disposal for the examination of the stomach and therefore should be explored as a possible means of mass examination. Other procedures such as gastroscopy and gastric aspiration with the study of the gastric contents using the Papanicolaou techniques may be of distinct help, too, but neither of these examinations appears to be of practical value when large numbers of individuals are to be examined. If one also considers the requirement that examinations be repeated at intervals, it is highly improbable that asymptomatic patients will return for either gastroscopy or aspiration. It has been adequately shown in tuberculosis control surveys that the method which attracts the asymptomatic individual is the one which is convenient and without discomfort. Time-consuming or painful procedures will automatically eliminate the greater part of the available voluntary patients. Thus it seems that, for the time being at least, the hope of obtaining early detection of gastric lesions lies in the field of roentgenology.

Conventional roentgen studies of the stomach entail both roentgenoscopy and roentgenography. The first of these two procedures is slow and requires the prolonged services of a highly trained physician. These facts quickly exclude the method as impractical for mass examination of the stomach even before one considers two other inherent objections, namely (*a*) the limited interpretability of present-day fluoroscopic screens and (*b*) the probability of permanent radiation damage to the fluoroscopist. Also, conventional roentgenography of the stomach requires the exposure of films of large size. The use of such films in the examination of large population groups can hardly be regarded as practical, not only because of the initial cost of the films but also because of the expense of time and money in handling, processing and storing the roentgenograms.

Any discussion of the use of roentgen procedures in the early detection of gastric cancer must consider the possible application of photofluorographic methods to the problem. Photofluorography has been extremely successful in the early detection of pulmonary lesions and it therefore may be useful in the discovery of gastric pathology. Furthermore the method is inexpensive and rapid in execution and does not require the services of a fluoroscopist. The principal disadvantages of the procedure include (*a*) the excessively large doses of radiation that until now have been necessary to produce satisfactory photofluorograms of the abdomen and (*b*) its unknown efficiency in the early detection of gastric neoplasms.

The excessive radiation dosage which may occur during photofluorography of the abdomen has recently been overcome by the application of Schmidt optics to photofluorographic camera equipment.[5] With cameras of the Schmidt type, it is now possible to make photofluorograms of the stomach with little more exposure than that used in conventional roentgenography. Thus, the only remaining problem concerning gastric photofluorography is its reliability of diagnosis. In an effort to evaluate this factor, a pilot survey has been established at The Johns Hopkins Hospital in which all patients above the age of forty who are admitted to the Dispensary Out-Patient Clinic of the Hospital during the

course of the study will be examined photofluorographically, for gastric pathology. The equipment employed for these examinations will be described in detail in Part II of this series. It will therefore suffice to say at this time that the apparatus incorporates Schmidt optics, examines patients in the recumbent position and delivers from 0.5 to 2.0 r (including backscatter) per exposure to the patient's skin.

The study has been limited to patients above the age of forty because the incidence of gastric carcinoma in individuals below that age is negligible. The number of nonsignificant cases with which the investigation is burdened will therefore be reduced to a minimum. Even so, statistical data indicate that one may expect to find only one man with gastric malignancy in every 700 men studied; in women, the expected prevalence of the disease is one individual in every 1,200 females. At first glance, it may appear to some that such a yield of pathology will be insufficient to test the photofluorographic method adequately. It is anticipated, however, that within each year of the study between 5,000 and 10,000 patients will be examined and that a minimum of 6 to 12 gastric carcinomas will pass through the unit. Furthermore, although the majority of the patients coming in for examination will have no symptoms referable to the gastrointestinal tract, a few will and these latter cases should increase the incidence of abnormal findings above that which occurs in wholly asymptomatic groups. It is noteworthy in passing that the number of persons whom one may expect to find with carcinoma of the stomach in general population groups of males and females above forty is approximately 1 in 900. Such an incidence may seem small but in reality it is only slightly less than that of significant pulmonary tuberculosis in the general population (1 in 300 to 500). Moreover, even though the yield is small certainly the method will be justified if thereby an early diagnosis of gastric cancer may be accomplished.

It is planned to pursue the survey for a period of approximately five years. During this time, all patients with abnormal photofluorograms will be restudied with conventional roentgenoscopic and roentgenographic techniques. Those who present changes suggesting gastric carcinoma thereupon will be operated upon surgically. As the study proceeds, survival data of operated patients whose diagnoses are confirmed pathologically will accrue and a comparison of such data with those presented in curve B of Figure 1 will permit an evaluation of the efficacy of the photofluorographic process in reducing the gastric cancer mortality.

As a part of the investigation it is also planned to collect a group of approximately 1,000 asymptomatic individuals and to examine them photofluorographically for gastric pathology at intervals of six months over a five year period. From this study it is hoped that an estimate of the interval at which photofluorographic examinations of the stomach should be repeated in the general population may be determined.

In subsequent publications of this series, the results of the investigation will be reported. It must be stated at this time that no preconceived notions regarding the place of photofluorography in the cancer problem are held. The study has been undertaken to determine the reliability of the photofluorographic process in the early detection of gastric malignancy, a process that has been virtually untried until the present time. The next paper of this series will describe in detail the photofluorographic equipment used in the investigation.

SUMMARY

It has been statistically shown that cancer of the stomach is a prevalent and rapidly fatal disease for which the only promising form of therapy, available today, is surgery. If surgery is to be successful resection must be done early in the course of the disease, prior to the appearance of symptoms. Thus, methods must be developed whereby large segments of the

population may be examined at regular intervals to find the asymptomatic but positive case. The most feasible method for carrying out this sort of an examination is the photofluorographic process. A pilot study has been established to determine the efficiency of this method using the male out-patient population of this hospital above the age of forty. The study will be pursued for a period of five years. Subsequent papers of this series will report the experimental findings.

Johns Hopkins Hospital
Baltimore 5, Maryland

REFERENCES

1. Dorn, H. F. Illness from cancer in the United States. *Pub. Health Rep.*, 1944, *59*, 33–48; 65–77; 97–115.
2. Pack, G. T. Radical surgical treatment of gastric cancer. *J. Nat. Cancer Inst.*, 1947, *7*, 337–344.
3. Walters, W., Gray, H. K., and Priestley, J. T. Carcinoma and Other Malignant Lesions of the Stomach. W. B. Saunders Co., Philadelphia, 1942. Chap. 22, by Berkson, J.
4. Wangensteen, O. H. Problem of gastric cancer. *J.A.M.A.*, 1947, *134*, 1161–1168.
5. Morgan, R. H., Gould, D. M., and Van Allen W. W. Two Danish photofluorographic cameras of the original Schmidt type. Am. J. Roentgenol. & Rad. Therapy, 1948, *59*, 416–419

THE DETECTION OF GASTRIC CARCINOMA BY PHOTOFLUOROGRAPHIC METHODS*†

PART II. EQUIPMENT DESIGN

By JOHN F. ROACH, ROBERT D. SLOAN, *and* RUSSELL H. MORGAN

BALTIMORE, MARYLAND

I. INTRODUCTION

THE success with which the photofluorographic process has been employed in the examination of large population groups for the early detection of chest pathology has led many radiologists to consider its application to the mass study of carcinoma of the stomach. By means of small film techniques it should be possible to examine rapidly and inexpensively large segments of the nation's adult population for the disease at regular intervals. Furthermore, the use of small film methods should reduce the time expended by physicians in the procedure to levels far below those needed in other roentgenologic techniques such as fluoroscopy and large film roentgenography; photofluorography therefore should effectively overcome the obvious impracticability that has been cited in the use of these latter procedures in mass roentgenologic studies of the stomach.

In spite of the ease with which photofluorography may be used in the study of gastric cancer, many radiologists have advised against such an application. It has been pointed out that although there is general agreement among the medical profession that roentgenologic methods are extremely useful in the early detection of pulmonary tuberculosis, there are no reliable data which indicate that these methods will be equally valuable in the early detection of carcinoma of the stomach. Furthermore, in the past, a combination of fluoroscopy and roentgenography has always been used in the examination of the stomach for pathology of any kind; the use of film techniques alone is completely untried. Some skepticism regarding their usefulness therefore seems justified. In addition to these objections, it is also known that for an adequate examination of the stomach by photofluorographic methods, undesirably large doses of radiation must be employed because of the relative inefficiency of the photofluorographic process. Almost *twenty* times as much radiation is needed in a photofluorographic exposure using equipment generally available today as in the making of a conventional roentgenographic film. Since conventional roentgenography of the stomach requires an exposure of the order of 0.5 roentgen, including backscatter, at the skin surface for every film made, it will therefore be evident that if a series of six films is exposed for each patient studied by the photofluorographic method (the number possibly required for a satisfactory examination) a total of 60 roentgens will be delivered to the patient's skin. Such an exposure, even though it may be divided among several fields, is certainly not inconsiderable especially when it is remembered that if pathology is suspected, conventional roentgenologic procedures will be necessary to confirm the impression and therefore require additional exposure.

The relatively large doses of radiation needed in the performance of gastric photofluorography have been a serious impediment to the application of the procedure on a mass basis. Recently, however, the employment of Schmidt optics in photofluorographic camera equipment and the development of faster fluorescent screens have made it possible to increase the efficiency of the photofluorographic process by a factor of almost twelve. By

* From the Department of Radiology, The Johns Hopkins University and Hospital.

† The work described in this paper was done under a contract between the National Cancer Institute and The Johns Hopkins University.

taking advantage of these contributions, photofluorography can now be performed with the expenditure of little more energy than that used in conventional roentgenography and, from a technical standpoint, gastric photofluorography has become an entirely practical procedure so long as these newer developments are used. Of course, the argument still prevails that gastric photofluorography is an untried procedure and that its usefulness in the early detection of carcinoma of the stomach may be doubted. However, since the method may be made free of technical difficulties and since the early detection of gastric cancer by all other methods is either unreliable or involves procedures that are generally impractical, it has been thought wise to establish a photofluorographic installation by which large numbers of persons within the age group in which carcinoma of the stomach is especially prevalent may be studied. Possibly from such an investigation a technique may be developed that will prove as valuable as photofluorography of the chest in the detection of pulmonary tuberculosis.

The remainder of this paper will be devoted to a description of the technical facilities which have been established for the study. Before we proceed to these discussions, however, it must be emphasized that no preconceived notions are held regarding the place that gastric photofluorography may have in the future in the diagnosis of carcinoma of the stomach. The investigation is being pursued only to determine whether or not the method, untried until the present and now relatively safe to perform, will have value.

II. TECHNICAL EQUIPMENT

The photofluorographic installation which has been established for the investigation of mass roentgenographic methods in the diagnosis of gastric carcinoma differs considerably from the small film units currently used in mass roentgenography of the chest. The nucleus of the installation is a 70 mm. Schmidt camera, constructed by the Danish engineer, Helm, and recently brought to this country by the Tuberculosis Control Division of the United States Public Health Service.[2] This camera has an f/ number rating of 0.75 and has a speed approximately 5 times greater than that of photofluorographic cameras commonly in use. Furthermore, measurements of resolving power made at the National Bureau of Standards indicate that the ability of the camera to record detail is equal to that of conventional cameras using 70 mm. film, in spite of its speed.

The high speed of the Schmidt camera is achieved by virtue of its unusual optical system in which the principal lenticular element consists of a large spherical mirror which picks up the light from the fluorescent screen and reflects it directly on the photofluorographic film. Since the aperture of the mirror is much larger than that which can be attained in lenses of the conventional refractor type, the proportion of the light delivered to the film from the screen in the Schmidt system is greater than in ordinary lenses.

A schematic diagram of a Schmidt camera is shown in Figure 1. There it will be seen that light emitted from a fluorescent screen *S*, is reflected by the spherical mirror *M*, on the photofluorographic film *F*, which itself is curved into a semispherical configuration. In addition to the spherical mirror, a single element, aspherical lens *L*, is placed in the optical system between the screen and mirror to correct for aberrations introduced by the mirror. An interesting constructional detail of this lens system is the positioning of the film between the fluorescent screen and the principal lenticular element, the mirror. Also, since the film must face the mirror it faces away from the fluorescent screen; its rear surface must therefore be protected from light emitted directly from the screen. This protection is accomplished by the enclosure *C*.

The Schmidt camera manufactured by Helm is approximately 18 inches in length; its diameter is about 13 inches. The camera

uses 70 mm. perforated film and produces an image 55 mm. square. A manual type film advance mechanism is used and includes an electrical interlock system which prevents the making of an exposure until the film has been advanced following the previous exposure. The focusing of the camera is unusually simple. An opening in the center of the mirror permits one to observe the surface of the film from the rear of the camera and thereby to focus the instrument under visual control. Interestingly, in the focusing process it is the film carriage that is moved rather than the lenticular elements.

The fluorescent screen employed in the installation is a Patterson type E-2, a screen which has approximately twice the sensitivity of the recently obsolete type B screen. With the increased speed provided by the Schmidt camera, this screen makes it possible to take photofluorographic films of the abdomen with exposures ranging from 50 to 100 milliampere-seconds at a tube potential of 95 kv. (peak) and at a tube-screen distance of 36 inches. This corresponds to a roentgen dosage at the skin surface of approximately 0.5 to 2 r including backscatter, or only slightly more than the dosage delivered in conventional roentgenography.

The size of the field covered by the photofluorographic screen is 15 inches square. Since the image size of the film is 55 mm. square, the minification of the camera is therefore seven times. Such a minification is not so great that the mucosal patterns of the stomach and small intestine cannot be clearly seen in the film.

In addition to the camera and screen, the photofluorographic system includes a special Liebel-Flarsheim cross-hatched stationary grid placed in apposition to the rear surface of the screen to prevent scattered radiation from fogging the fluorescent images. Since the quantity of scattered radiation to be removed during abdominal filming is materially greater than that during roentgenography of the chest, the conventional wafer grid used in chest photofluorographic units did not prove adequate in this installation.

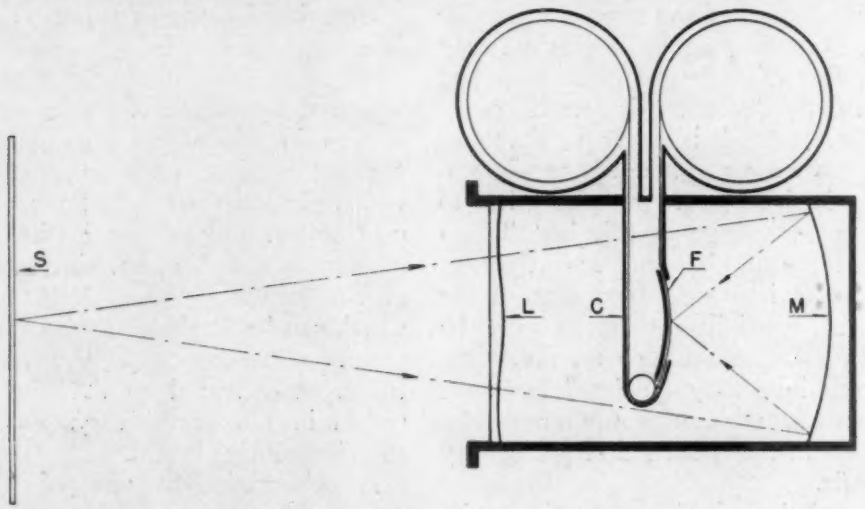


FIG. 1. Schematic diagram of Schmidt camera. *M*, spherical mirror; *L*, aspherical lens; *F*, photofluorographic film; *C*, film enclosure; *S*, fluorescent screen.

Early in the design of the photofluorographic installation, it was decided to arrange the equipment so that the examination of the patients might be carried out only in the recumbent position. It was realized that if the patients were examined in the erect posture, large regions of the stomach in and near the fundus would not be satisfactorily visualized in mucosal relief or gross outline; certainly, it was

desired that such incompleteness of examination should be avoided if at all possible. It was therefore decided to mount the grid, fluorescent screen and the photofluorographic camera below a conventional horizontal roentgenographic table. Such an arrangement, however, introduced immediate difficulties. As stated heretofore, the Helm camera is 18 inches long; furthermore, the screen-camera distance that is required approaches 42 inches. Thus if conventional mounting of screen and camera were followed and the end of the camera allowed to rest on the floor below, the surface of the table would occupy a position 5 feet above the floor. Such a position is obviously inconveniently high. The possibility of hanging the grid-screen-camera assembly above the table with the roentgen tube located under the table was then considered. However, it was immediately recognized that such an arrangement would be dangerous in that the grid-screen-camera assembly might break loose from its mounting and crash on the patient below. Finally the arrangement illustrated schematically in Figure 2 was investigated and found to overcome satisfactorily the foregoing difficulties. In this arrangement, the grid *G*, and fluorescent screen *S*, of the photofluorographic system are mounted in a light-proof hood *H*, directly below the surface of the roentgenographic table *R*. The light from the screen is directed downward and falls on a front-surfaced Pancro mirror *M*, whose surface is placed at 45° to the plane of the screen. This mirror redirects the fluorescent light into the Schmidt camera *K*, whose long axis now is parallel to the long axis of the roentgenographic table. With this system the arrangement of the various components below the roentgenographic table is such that the table top may be at a convenient level above the floor and the end of the camera may be in a satisfactory position for the loading and advancing of the film. It may be argued by some that the loss of light incurred by the mirror is a serious disadvantage to the system. However the loss is less than 7 per cent and is therefore of no concern.

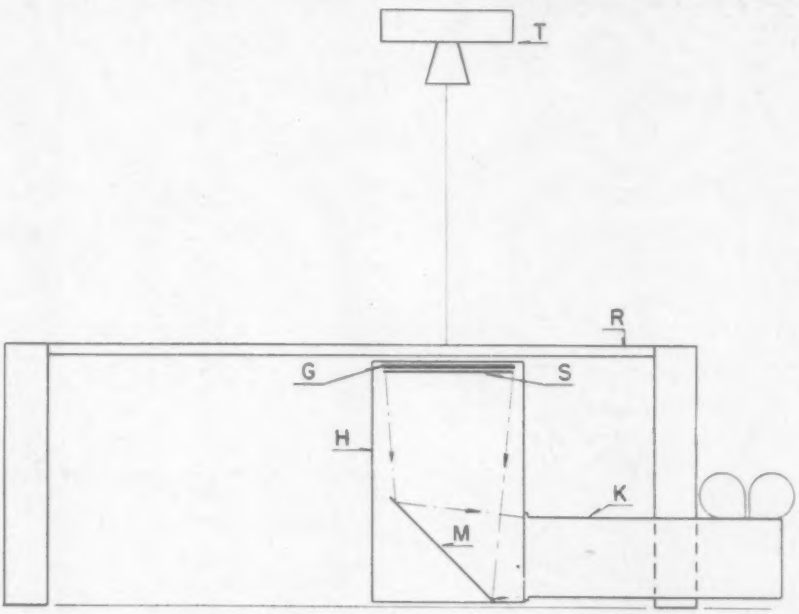


Fig. 2. Schematic diagram of photofluorographic unit developed for mass roentgenography of the stomach. *T*, roentgen tube; *R*, roentgenographic table; *G*, wafer grid; *S*, fluorescent screen; *H*, light-proof hood; *M*, front-surfaced mirror; *K*, Schmidt camera.

It was necessary to choose the position of the 45° mirror rather carefully in the installation. Early experiments indicated that if the mirror were placed too close to the fluorescent screen, light from the screen could reflect back to the screen surface and badly fog the fluorescent images appearing on it. These reflection problems, however, were found to be effectively corrected by increasing the distance between the screen and mirror to the point at which light from the screen could not be reflected back to the screen under any circumstances. The position of the mirror shown in Figure 2 fulfills this requirement.

The photofluorograph is powered by a standard 200 milliampere, four-valve generator operating at 95 kv. (peak) and controlled by a photoelectric automatic timer of essentially conventional design.[3] The phototube scans a small area near the center of the field of examination. Exposure times are of the order of 0.5 second. A rotating anode tube with a focal spot 1.5 mm. square is employed and the tube-screen distance is 36 inches. A photograph of the complete installation is shown in Figure 3.

An impression of the quality of the films obtained with the unit may be gained from Figure 4 where films taken in the anteroposterior and right anterior oblique position after the ingestion of a small amount of barium and in the posteroanterior and right anterior oblique position after the ingestion of a large amount of barium are reproduced. These positions permit one to view the mucosal pattern and gross outline of the major portions of the stomach. It remains to be seen how well pathologic processes within the stomach may be detected by the method.

It is planned to examine 40 patients per day during the next several months as a

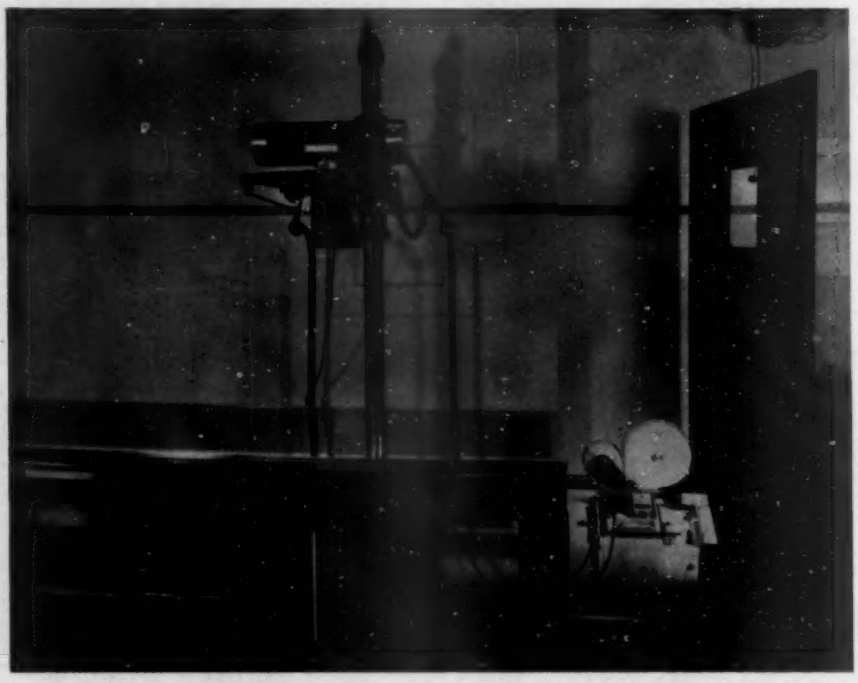


FIG. 3. Photograph of photofluorographic unit developed for mass roentgenography of the stomach.

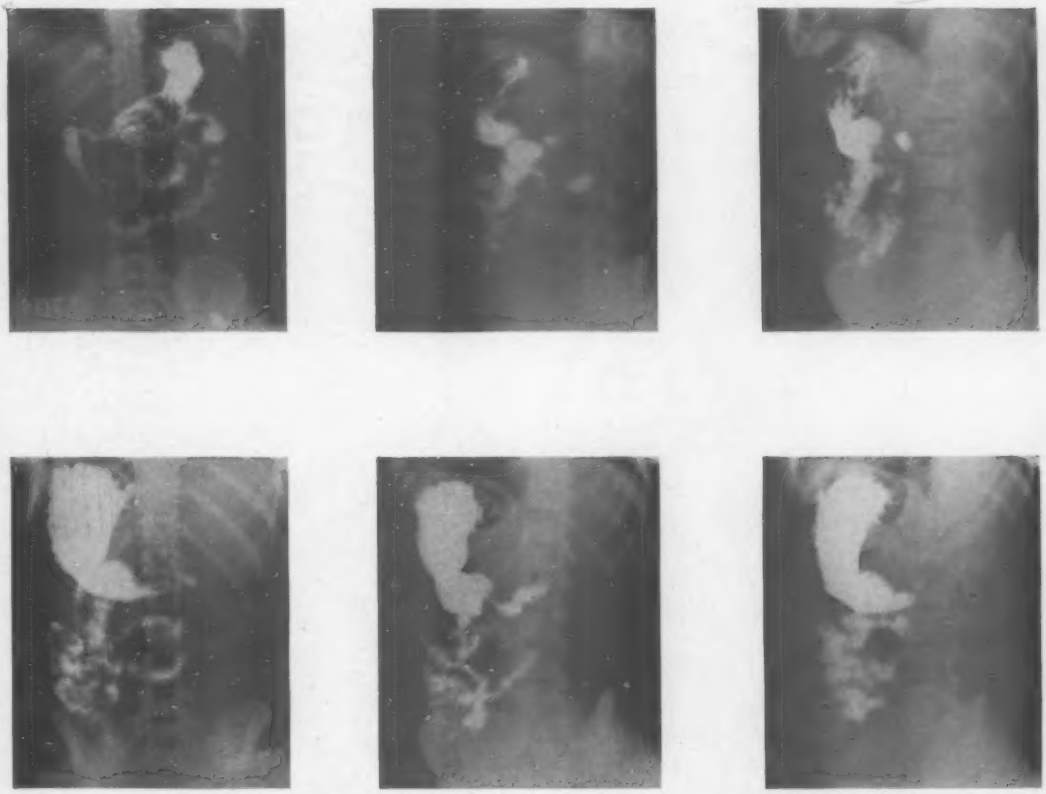


Fig. 4. Reproductions of 70 mm. photofluorographic films of the stomach taken with the patient in the recumbent position. The upper three films were made after the ingestion of 1½ ounces of barium mixture; the lower three films were made after 5 ounces of barium had been ingested. In each case two views in the right anterior oblique projections were taken to demonstrate the progression of peristalsis.

pilot study to determine the best technical procedures to be followed with the equipment. The results of this investigation will be reported in subsequent publications. If the data are encouraging, much more extensive studies on large population groups with the performance of possibly 200 examinations per day will be undertaken. Preliminary trials indicate that the equipment should be able to accommodate such a volume of work within an eight hour day if not more than six films per patient are made.

III. SUMMARY

Photofluorographic equipment by which the roentgenographic examination of large population groups for gastric carcinoma may be carried out with the application of little more radiation than that employed in conventional roentgenography is described. The apparatus consists of a standard 200 milliampere generator, a rotating anode tube, and a grid-screen-camera assembly using a Patterson type E-2 screen and a Schmidt camera. The grid-screen-camera assembly is mounted beneath a horizontal roentgenographic table to permit the examination of patients in the recumbent position, thereby assuring a completeness of study not attainable with other positions. Results of the use of the equipment in the early detection of gastric carcinoma will be reported in subsequent papers.

Johns Hopkins Hospital
Baltimore 5, Maryland.

REFERENCES

1. Symposium on Schmidt optics in photofluorography. AM. J. ROENTGENOL. & RAD. THERAPY. To be published.
2. MORGAN, R. H., GOULD, D. M., and VAN ALLEN, W. W. Two Danish photofluorographic cameras of the original Schmidt type. AM. J. ROENTGENOL. & RAD. THERAPY, 1948, *59*, 416–419.
3. MORGAN, R. H., and HODGES, P. C. Evaluation of automatic exposure control equipment in photofluorography. *Radiology*, 1945, *45*, 588–593.
4. ROACH, J. F., SLOAN, R. D., and MORGAN, R. H. Detection of gastric carcinoma by photofluorographic methods. Part I. Introduction. AM. J. ROENTGENOL. & RAD. THERAPY, Feb., 1949, *61*, 183–187.

Vol. 61, No. 2

THE AZYGOS LOBE: ITS INVOLVEMENT IN PULMONARY DISEASE*†

By EMIL ROTHSTEIN, M.D.
Tuberculosis Service, Veterans Hospital
WOOD, WISCONSIN

A COMMON anomaly found in reading roentgenograms of the chest is the presence of an azygos lobe or fissure. This occurs so frequently that no special report would be of interest if it dealt with this condition in the otherwise normal chest. I wish, however, to report a series of cases in which this anomaly was involved in various pulmonary diseases. Localization of pulmonary pathology in this area is sufficiently unusual to be worthy of note.

In the normal human being the azygos vein travels cephalad in the posterior portion of the right half of the thorax, lying anterior to the inner surfaces of the ribs and posterior to the parietal pleura. It usually ascends to about the fifth rib and then curves anteriorly to join the superior vena cava just before this structure enters the right auricle. The exact point of entry varies somewhat, but in the normal individual the azygos vein is medial to the right upper pulmonary lobe and to the parietal and visceral pleurae as it crosses the root of the lung. In the condition diagnosed as azygos lobe the vein runs lateral to its normal position. When it curves forward and medially, therefore, to join the superior vena cava it encounters the right upper lobe and in traversing it creates a new fissure in the lung. It does so by invaginating the posterior parietal pleura, and creates a cleft in the visceral pleura and in the right upper lobe. A frontal section through the right lung at this point (Fig. 1) would reveal the structures to be in the following order, going medially—right upper lobe, visceral pleura, parietal pleura, azygos vein, parietal pleura, visceral pleura, azygos lobe, visceral pleura, parietal pleura, mediastinal structures. The vein itself is never intrapleural.

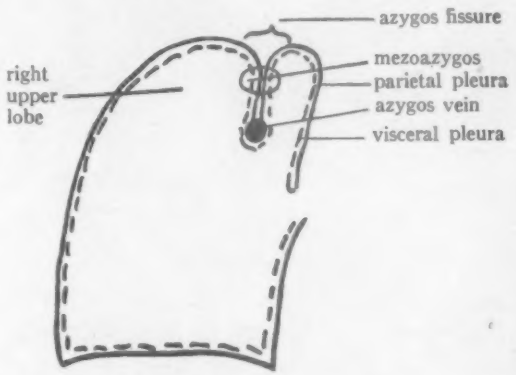


FIG. 1. Diagram of frontal section of the chest when azygos lobe is present, illustrating the anatomical relationships.

As a result of this anomaly, a septum is formed which is composed of two layers of the parietal pleura. This is thus a defect of septation rather than of lobation. This septum is known as the mesoazygos from its analogy with the mesentery. The azygos vein traverses its free edge in an analogous fashion to the bowel. Because of this septum of parietal pleura the azygos fissure differs from all the other pulmonary fissures. It is the only one which persists in the pleural space after the lung has been removed.

Occasionally disease processes affecting the right upper lung field will involve the azygos lobe alone, or its fissure, or the remainder of the right upper lobe without affecting the extra lobe. Pneumothorax will separate the right upper lobe from the

* From the Tuberculosis Service, Dr. Gerald D. Guilbert, Chief.
† Published with permission of the Chief Medical Director, Veterans Administration, who assumes no responsibility for the opinions expressed or conclusions drawn by the author.

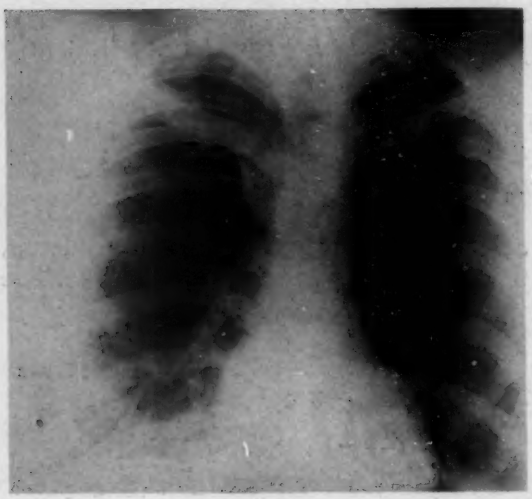


Fig. 2. Case 1. Azygos lobe in an otherwise normal chest.

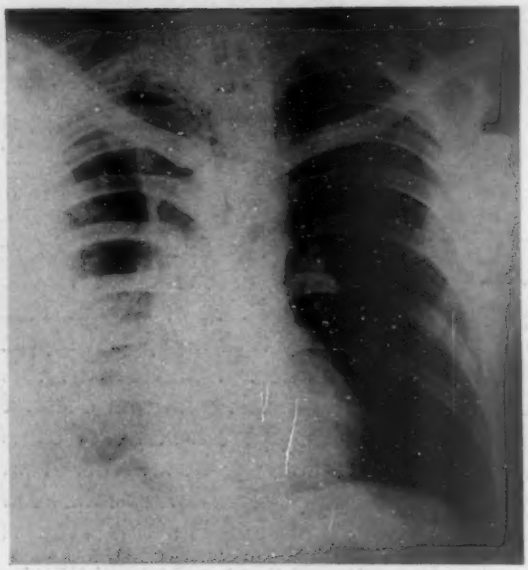


Fig. 4. Case 1. Chronic fibrous interlobar pleurisy.

azygos lobe just as it does the upper middle and lower lobes. Pleural effusion may similarly separate the lobes, creating an azygos interlobar effusion. Consolidation may affect the anomalous lobe alone or the remainder of the upper lobe, sparing the azygos.

Case 1 is that of a tuberculous effusion in a patient with an azygos lobe. Figure 2 shows the chest before the onset of the effusion and illustrates the appearance of an azygos fissure in an otherwise normal chest. Figure 3 shows a general pleural effusion with azygos interlobar effusion. Figure 4 pictures the condition after resolution of the effusion, leaving a chronic fibrous pleurisy of the general pleural space and the azygos interlobar fissure.

Case II is that of a patient with bilateral pulmonary tuberculosis. Figure 5 illustrates the

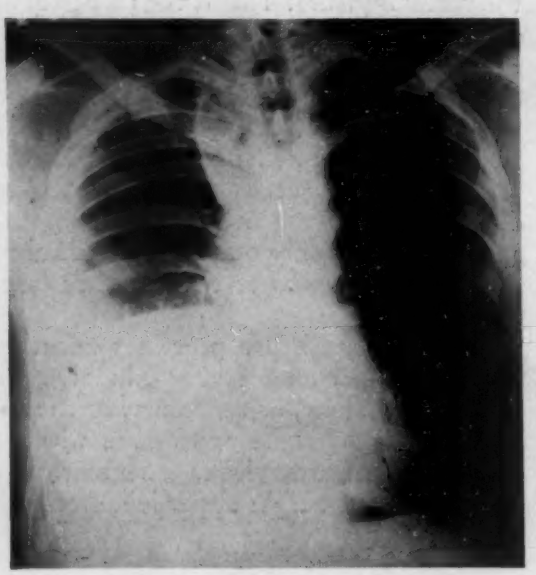


Fig. 3. Case 1. Azygos interlobar effusion with general pleural effusion.

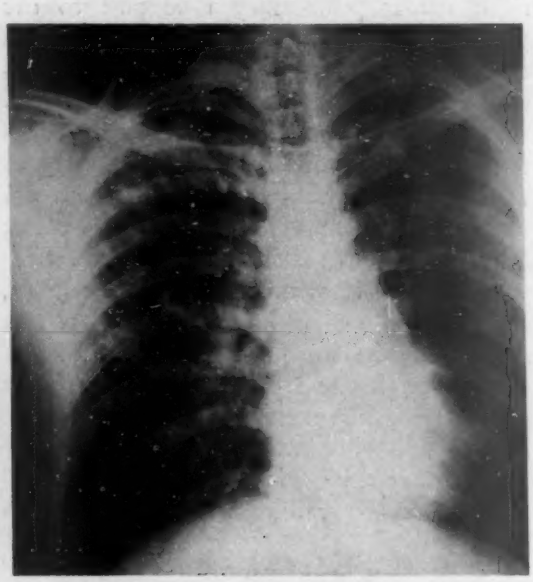


Fig. 5. Case II. Far advanced tuberculosis in a patient with azygos lobe.

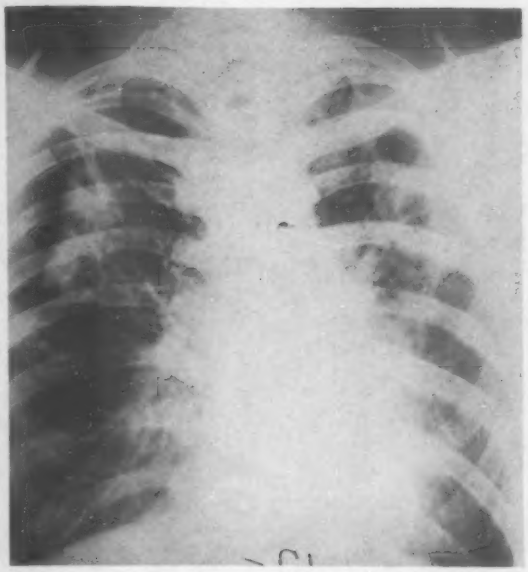


Fig. 6. Case II. Artificial pneumothorax has been induced and the azygos lobe can be seen clearly separated from the right upper lobe.

condition, showing the azygos fissure, with little or no involvement of the azygos lobe in the disease process. In Figure 6 artificial pneumothorax has been instituted on the right. The azygos lobe appears well expanded and well aerated and clearly separated from the remainder of the right lung. The disease area is

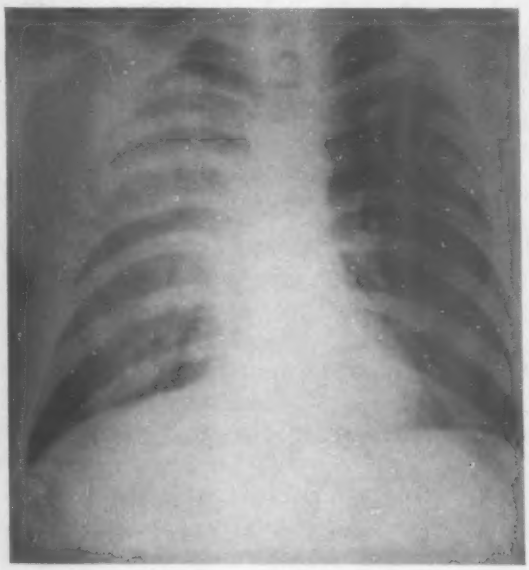


Fig. 7. Case III. Blastomycosis affecting the entire right upper lobe but leaving the azygos lobe as a clear oval area of increased radiolucency.

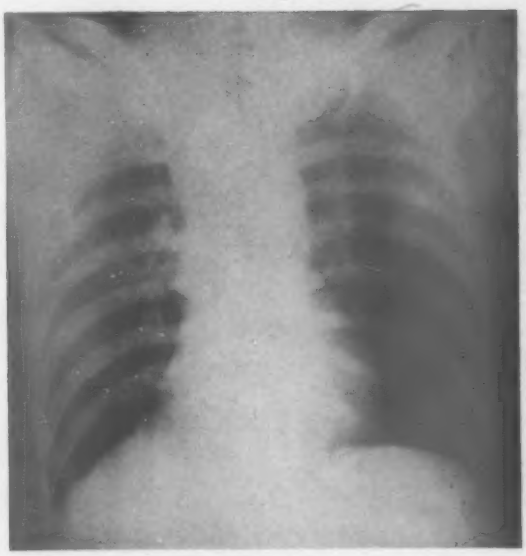


Fig. 8. Case IV. Pulmonary tuberculosis affecting the azygos lobe without the right upper lobe being involved.

held out by adhesions. The azygos lobe appears to be widely adherent to the mediastinum. However, subsequent roentgenograms revealed that the azygos lobe collapsed and disappeared from sight. It was not visualized at a subsequent intrapleural pneumonolysis. However, on

Fig. 9. Case IV. Same case with an overexposed film revealing the presence of multiple cavities.

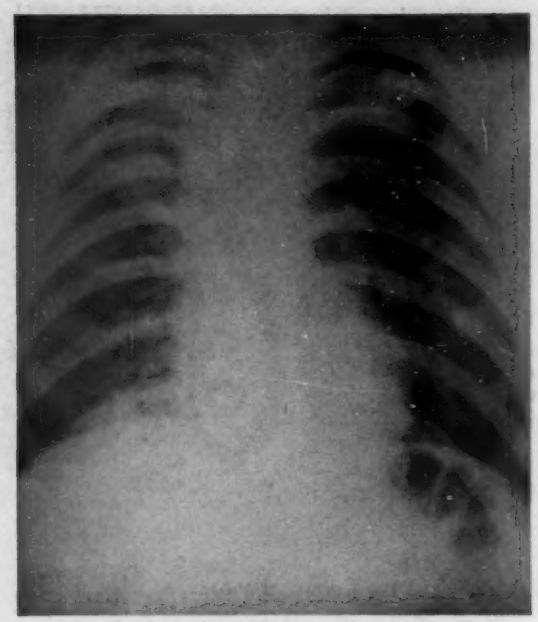


FIG. 10. Case v. Far advanced tuberculosis involving the major portion of the right lung.

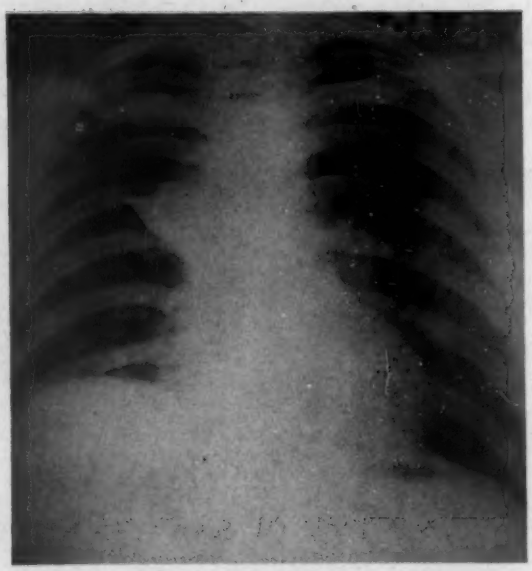


FIG. 11. Case v. Artificial pneumothorax has been induced. The right upper lobe has become entirely atelectatic.

later roentgenograms, a linear shadow could be seen in the region of the previously seen azygos fissure; this probably represented the reduplication of the parietal pleura as seen in Figure 1.

CASE III is one of pulmonary blastomycosis*

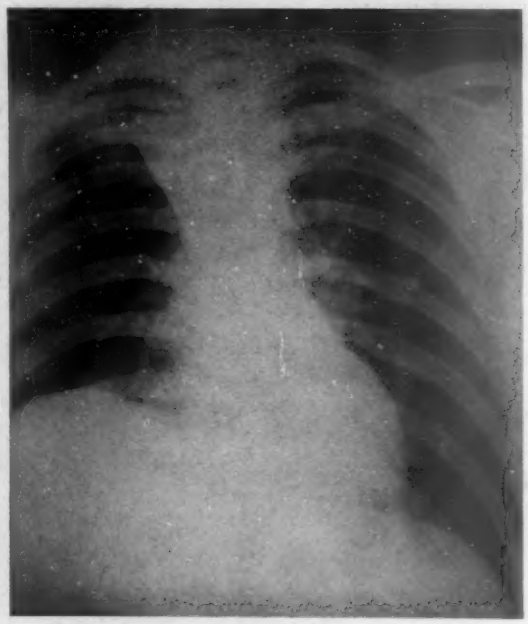


FIG. 12. Case v. "Peudo-azygos" lobe due to atelectasis and fibrosis of the right lung after the pneumothorax was abandoned.

in which the entire right upper lobe was involved, sparing the azygos lobe (Fig. 7).

CASE IV is a patient with pulmonary tuberculosis affecting the azygos lobe alone (Fig. 8 and 9†).

CASE V illustrates a "pseudo-azygos" lobe developing in the right upper lobe which was affected by extensive tuberculosis and was treated with artificial pneumothorax. Atelectasis developed while the lung was collapsed and the shrunken upper lobe now resembles an azygos lobe (Fig. 10, 11 and 12).

SUMMARY AND CONCLUSIONS

The azygos lobe and fissure may be involved by pulmonary and pleural disease processes similar to the other lobes. Illustrative cases are presented. A knowledge of the roentgen appearances of these changes may be of value in the interpretation of an occasional atypical roentgenogram.

Veterans Hospital
Wood, Wisconsin

* Permission to use this case was kindly granted by Dr. M. Lustok, Consultant on Chest Diseases; it will reported in greater detail individually.

† Permission to use these roentgenograms was kindly granted by Dr. J. Marks, Roentgenologist at Milwaukee County General Hospital.

Vol. 61, No. 2

OCCURRENCE AND DIAGNOSIS OF DILATATION OF THE AORTA DISTAL TO THE AREA OF COARCTATION*

By FELIX G. FLEISCHNER, M.D.
BOSTON, MASSACHUSETTS

THERE is little concerning coarctation of the aorta of the adult type that is not generally known. The anatomical changes are fully recognized. The clinical picture, including diagnosis, prognosis and complications, has been analyzed.[1,2,3] The surgical treatment has added some new details to our knowledge and has improved the prognosis.[4,5] Angiocardiography has brought to light an "atypical type of coarctation of the aorta, with absence of the left radial pulse."[6]

The diagnosis is based upon a strong pulse in the upper extremities, combined with a weak or absent pulse in the lower extremities, and confirmed by the evidence of collateral circulation and by the roentgen signs.[7,8] These roentgenologic signs, particularly the notching of the ribs, have special significance in that sometimes they are observed incidentally, and first call attention to the presence of this cardiovascular anomaly.

It has been known from postmortem findings that the aorta is often dilated in a bulbous fashion just beyond the site of the coarctation. This dilatation may be due to congenital weakness of the wall of the aorta or to eddy formation beyond the constriction or to both. Gross, recently reporting to this Association on surgical management of coarctation of the aorta, stated that this dilatation of the aorta may cause difficulties. The proximal and distal aortic stumps have to be anastomosed and this may be difficult if they are greatly different in caliber; moreover, the thinning of the wall may complicate the suturing. Prior knowledge of such dilatation may even influence the indication for this operation.

This statement by Gross has prompted me to report on the following observation:

A male patient, aged thirty-three, was seen at the Beth Israel Hospital in July, 1943. He presented the complete catalogue of the classical signs and symptoms of coarctation of the aorta, including also the roentgen signs.

In roentgenoscopy after swallowing barium the patient showed an unusual bending of the esophagus to the right and anteriorly (Fig. 1). According to the topographic relation between esophagus and descending aorta, this finding suggested the presence of a spindle-shaped dilatation of this portion of the aorta.

The patient died of a cerebral hemorrhage caused by rupture of an aneurysm of the right middle cerebral artery. The autopsy report stated: "In the distal portion of the aortic arch, 0.3 cm. distal to the physiologic scar of the ductus arteriosus, a narrowing of the aortic lumen was found. Seen from above, the aorta forms a tunnel leading into a slit-like lumen of 0.15 cm. in diameter. Distal to the coarctation the aorta is dome shaped. A probe can be passed through the narrowing. . . . The aorta measures 30 mm. in diameter above the stricture, 45 mm. below."

Before opening the chest, Dr. M. J. Schlesinger, pathologist, made an injection preparation with lead phosphate. A roentgenogram, taken in the left oblique position to match the clinical film, is shown here (Fig. 2). Clearly visible are the filled left ventricle, its thickened wall, the dilated ascending aorta, the dilated great vessels with the wide collateral pathways, the constriction of the descending aorta and the spindle-shaped dilatation distal to it. From the comparison of the antemortem and postmortem films it is evident that the displacement of the esophagus was caused by the dilatation of the aorta. Correctly interpreted, it is diagnostic of such a dilatation. This observation has been made in 2 other instances.

* From the Department of Radiology, Beth Israel Hospital and Harvard Medical School. Presented at the meeting of the New England Heart Association, March 29, 1948.

Discussion of the differential diagnostic significance of this displacement of the esophagus is not intended. Dilatation and tortuosity of the descending aorta not infrequently cause a similar displacement of the esophagus and a primary or metastatic growth in the mediastinum as well as a prevertebral abscess may occasionally produce similar pictures. This observation is presented solely to call attention to the roentgenologic recognition of this anatomic feature in instances of established coarctation of the aorta.

FIG. 1. Clinical roentgenogram, left oblique view. The barium-filled esophagus curves to the right anteriorly, starting this deflection just above the level of the carina.

SUMMARY

In coarctation of the aorta there may occur a bulbous or spindle-shaped dilatation of the descending aorta immediately beyond the constriction. This dilatation can be recognized reoentgenologically by a typical displacement of the esophagus. In cases where operation is planned, knowledge of this anatomical detail is of value to the surgeon.

Beth Israel Hospital
Boston, Mass.

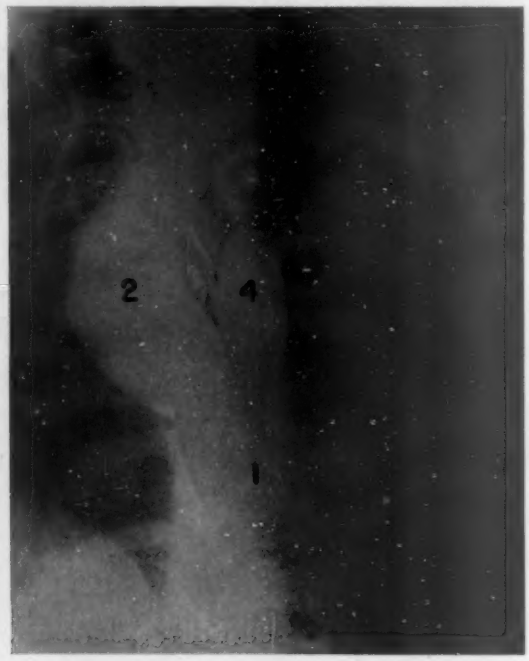


FIG. 2. Postmortem roentgenogram, after opacification of heart and vessels, left oblique view. Retouched. The left ventricle (*1*), ascending aorta (*2*) and the stricture at the junction (*3*) of the aortic arch and the descending aorta are visible. The bulbous dilatation of the descending aorta (*4*) corresponds, in location and shape, to the displacement of the esophagus on the clinical roentgenogram.

REFERENCES

1. ABBOT, M. E. Coarctation of aorta of adult type; statistical study and historical retrospect of 200 recorded cases with autopsy, of stenosis or obliteration of descending arch in subjects above age of two years. *Am. Heart J.*, 1928, *3*, 574–618.
2. BLUMGART, H. L., LAWRENCE, J. S., and ERNSTENE, A. C. Dynamics of circulation in coarctation (stenosis of isthmus) of aorta of adult type; relation to essential hypertension. *Arch. Int. Med.*, 1931, *47*, 806–823.
3. LEWIS, T. Material relating to coarctation of aorta of adult type. *Am. Heart J.*, 1933, *16*, 205–243.
4. GROSS, R. E. Surgical Treatment of Abnormali-

ties of the Heart and Great Vessels. Charles C Thomas, Springfield, Illinois, 1947.
5. Crafoord, C., and Nylin, G. Congenital coarctation of the aorta and its surgical treatment. *J. Thoracic Surg.*, 1945, *14*, 347–361.
6. Grishman, A., Sussman, M. L., and Steinberg, M. F. Atypical coarctation of aorta, with absence of left radial pulse. *Am. Heart J.*, 1944, *27*, 217–224.
7. Roesler, H. Clinical Roentgenology of the Cardiovascular System. Second edition. Charles C Thomas, Springfield, Illinois, 1943.
8. Ernstene, A. C., and Robins, S. A. Roentgenologic diagnosis of stenosis of descending arch (coarctation) of aorta. Am. J. Roentgenol. & Rad. Therapy, 1931, *25*, 243–246.

LEFT ATRIAL CALCIFICATION IN RHEUMATIC HEART DISEASE*

By BERNARD S. EPSTEIN, M.D.
BROOKLYN, NEW YORK

THE roentgenologic visualization of the walls of the left atrium by endocardial calcification arouses interest not only because of its rarity but also on account of the information made available concerning anatomical relationships. Begg[1] recently reported a patient with extensive calcification of the left atrium and another is mentioned by Kerley.[11] Together with the 3 reported here, there are but 5 such patients in the available literature in which the diagnosis was made roentgenologically during life. Recently Frade Fernandez and Torres Ruiz[4] reported an instance of total calcification of the left atrium following an old mural endocarditis, but the condition was unrecognized roentgenologically. Stewart and Branch[13] reported with pathologic observations a similar case in 1924, and noted the rheumatic etiology.

Left atrial calcification may occur following retrogressive myocardial or endocardial damage. The underlying damage in the present cases in all probability was the endocardial lesion originally described by MacCallum.[9,10] This occurs characteristically as a thickened, corrugated plaque on the wall of the left atrium extending upward from the root of the posterior leaflet of the mitral valve. While the MacCallum plaque is a frequent consequence of rheumatic endocarditis, calcification within the plaque is relatively uncommon. Gross[6] could find but one instance in the 87 cases studied histopathologically. The description of the microscopic changes by Gross,[6] Von Glahn[15] and Von Glahn and Pappenheimer[16] deserves careful study.

Calcification of the left atrium has also been described as part of the syndrome of metastatic calcinosis. This is a rare condition, and to my knowledge there is no reported instance in which the diagnosis was made roentgenologically during life. This type of calcification occurs without previous endocardial damage, and in the 2 cases observed by me and previously reported by Grayzel and Lederer[5] was of a delicate, egg-shell consistency which was difficult to identify on the postmortem roentgenograms of the heart.

The present communication is concerned with 3 patients with rheumatic heart disease and mitral stenosis and insufficiency in whom the left atrial calcification was identified and studied during life.

CASE REPORTS

CASE 1. A. W. (Hosp. No. 296699), female, aged forty-five, was first aware of her cardiac condition after an episode of dyspnea on exertion at the age of twenty-five. There was no history of rheumatic fever. Physical examination at the age of thirty-two revealed a loud apical presystolic murmur ending in a sharp first sound. The second pulmonic sound was accentuated, and her blood pressure was 120/80. Teleroentgenographic examination of the chest at that time showed no change in the heart outline, and electrocardiographic examination was normal.

Roentgenologic examination of the chest three years later showed a prominence of the upper left heart border interpreted as a "mitral contour." Her physical signs were unchanged. Auricular fibrillation appeared at that time.

One year ago she was admitted with bronchopneumonia and physical examination revealed a loud apical systolic and diastolic murmur, auricular fibrillation and bronchopneumonia.

Fluoroscopic and roentgenographic examination of the chest showed the heart to be triangular in appearance. The entire left atrium was outlined by calcification, and large deposits were also present in the mitral leaflets which were depressed to about 1.5 cm. above the middle third of the left diaphragm. The left atrial wall was within the heart contour, and its right border approached the right heart border

* From the Radiologic Service of M. G. Wasch, M.D., The Jewish Hospital of Brooklyn, Brooklyn, N. Y.

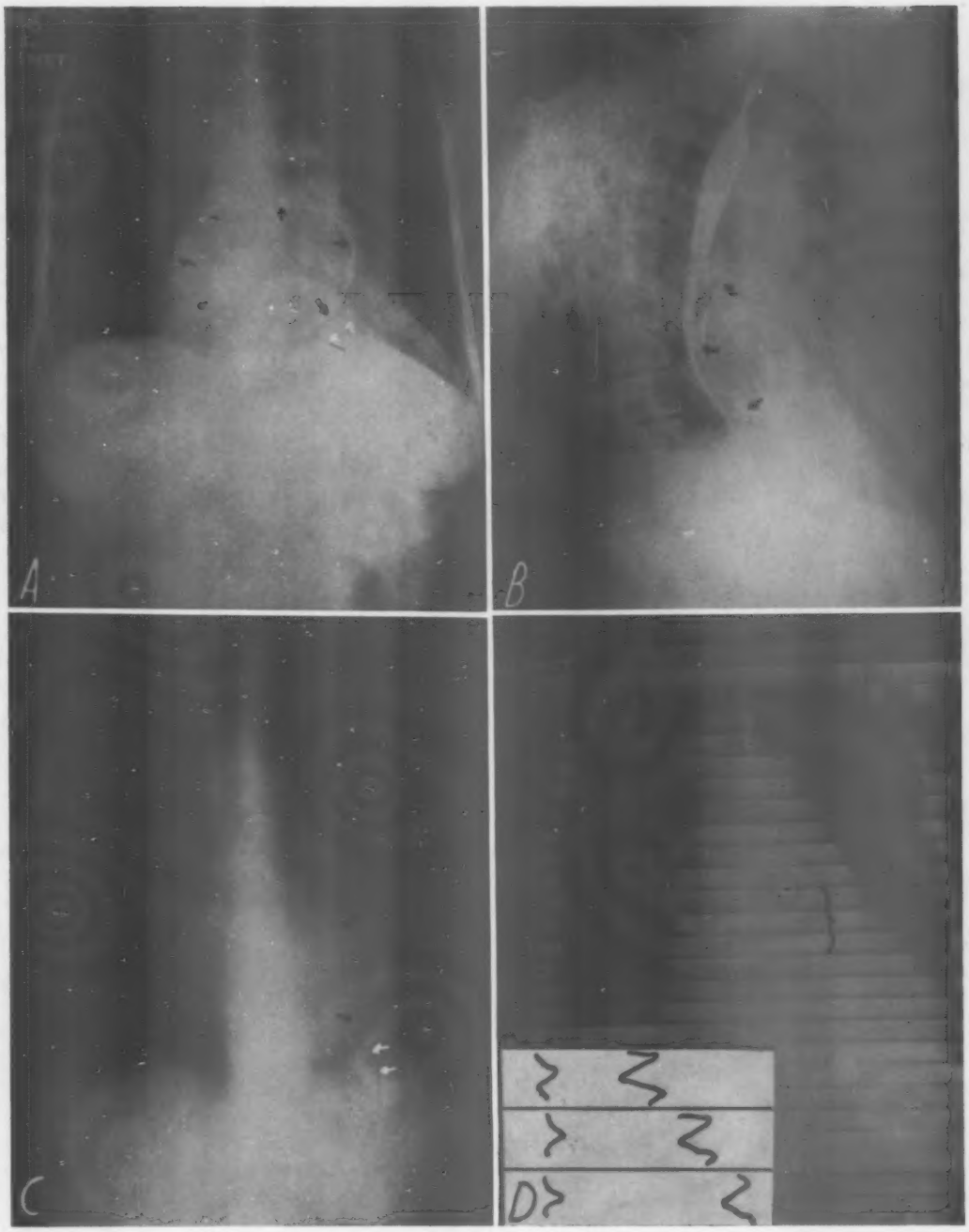


FIG. 1. Case 1, *A*, overexposed teleroentgenogram. The periphery of the left atrium is outlined by the calcified endocardium (black arrows). Calcification of the mitral valve is present (white arrows). *B*, right anterior oblique roentgenogram. The black arrows indicate the posterior wall of the left atrium. Only the segment in close apposition with the esophagus lies within the displaced esophageal arc. Above and beneath, the calcified left atrial wall is appreciably separated from the esophagus, indicating that the posterior displacement of the esophagus does not accurately portray the posterior wall of the atrium. *C*, laminagram taken 12 cm. from the posterior chest wall. The black arrows indicate the atrial calcifications, and the white arrows the mitral valve calcification. *D*, kymogram. The insert shows the pulsation of the atrial wall in relation to the ventricular pulsation. During atrial systole the ventricle is in diastole.

closer than the left side approached the left heart border. The left main bronchus was not elevated, and a space of 1.5 cm. existed between the superior wall of the left atrium and the inferior margin of the left main bronchus. In the right anterior oblique position there was close approximation of the point of greatest convexity of the calcified posterior wall of the left atrium to the esophagus, but above and beneath this site the atrial contour curved away from the esophagus. The thickness of the calcific shadow was 2 mm. in its greatest depth.

Laminagraphic examination of the chest showed the mitral valve calcifications to better advantage, and the left atrial calcification was somewhat more clearly portrayed.

Kymographic examination showed opposing pulsations of the right ventricle and left atrial calcifications, definitely localizing the deposits to the walls of the atrium. The height of the ventricular waves was 0.7 cm. and of the atrial wave 0.3 cm.

CASE II. A. O'S. (Hosp. No. 218646), female, aged thirty-five, had chorea at the age of nine. When seen during an episode of bronchopneumonia at the age of nineteen she had a loud blowing apical systolic murmur and a pericardial friction rub. Teleroentgenographic examination of the chest at that time revealed prominence of the middle of the left heart border in addition to the bronchopneumonic changes. Electrocardiographic examination showed erect, high, notched P waves in the first and second leads.

At the age of twenty-three she had an episode of congestive heart failure with dyspnea, orthopnea, palpitation, vomiting, weakness and cough. Physical examination disclosed a loud apical systolic and diastolic murmur and a diastolic thrill at the apex. Auricular fibrillation appeared at this time. Since then she has been observed during several bouts of congestive failure, and her response to treatment has been excellent.

Fluoroscopic and roentgenographic examination of her heart revealed a triangular configuration when she was twenty-eight and thirty-three years old, and no change occurred over this five year period. There was considerable enlargement of the right ventricle and less left ventricular enlargement. The left atrium displaced the esophagus posteriorly and to the right. A calcific deposit was seen in the midportion of the left border of the left atrium about 0.5 cm. from the heart border. At first this was thought to be a pericardial plaque, but fluoroscopic and kymographic studies revealed that during ventricular systole the calcification assumed a position corresponding to atrial diastole. The amplitude of pulsation of the ventricle was 1.2 cm. and of the atrial calcification 0.3 cm. The left main bronchus was not elevated and was separated from the left atrial calcification by 0.8 cm. A considerable portion of the right lateral border of the heart was formed by the dilated left atrium.

CASE III. R. S. (Hosp. No. 252624), female, aged forty-nine, had rheumatic fever at the age of twenty years. Physical examination during her fourth pregnancy at the age of twenty-nine disclosed systolic and presystolic apical murmurs, a systolic apical thrill and auricular fibrillation. Slight liver enlargement was present. This was the first she knew of her cardiac condition. Since 1929 she had been observed during several bouts of congestive heart failure and her response to treatment has been excellent. Electrocardiographic studies showed right axis deviation, inversion of all the T waves and slight depression of the R-T segments in the second and third leads.

Fluoroscopic and roentgenographic examination of the heart showed a triangular configuration. The left atrium was dilated, displacing the esophagus posteriorly and to the right. A large calcific deposit was seen within the left heart border, the point of greatest convexity being 2 cm. from the heart border. In the right anterior oblique position there was approximation of the most convex part of the calcific arc of the esophagus, the superior and inferior portions being separated from the esophagus. No elevation of the left main bronchus was present, and the two structures were visibly separated. Small calcific deposits were seen in the mitral leaflets.

Kymographic studies showed opposite pulsations in the calcified deposit in the left atrial wall as compared with the ventricle. The height of the ventricular waves was 1.0 cm. and of the atrial wave 0.3 cm.

DISCUSSION

The roentgenologic identification of left atrial calcification should not be difficult if the deposit is sufficiently dense. In the cases reported here the thickness of the calcification measured up to 2 mm. The

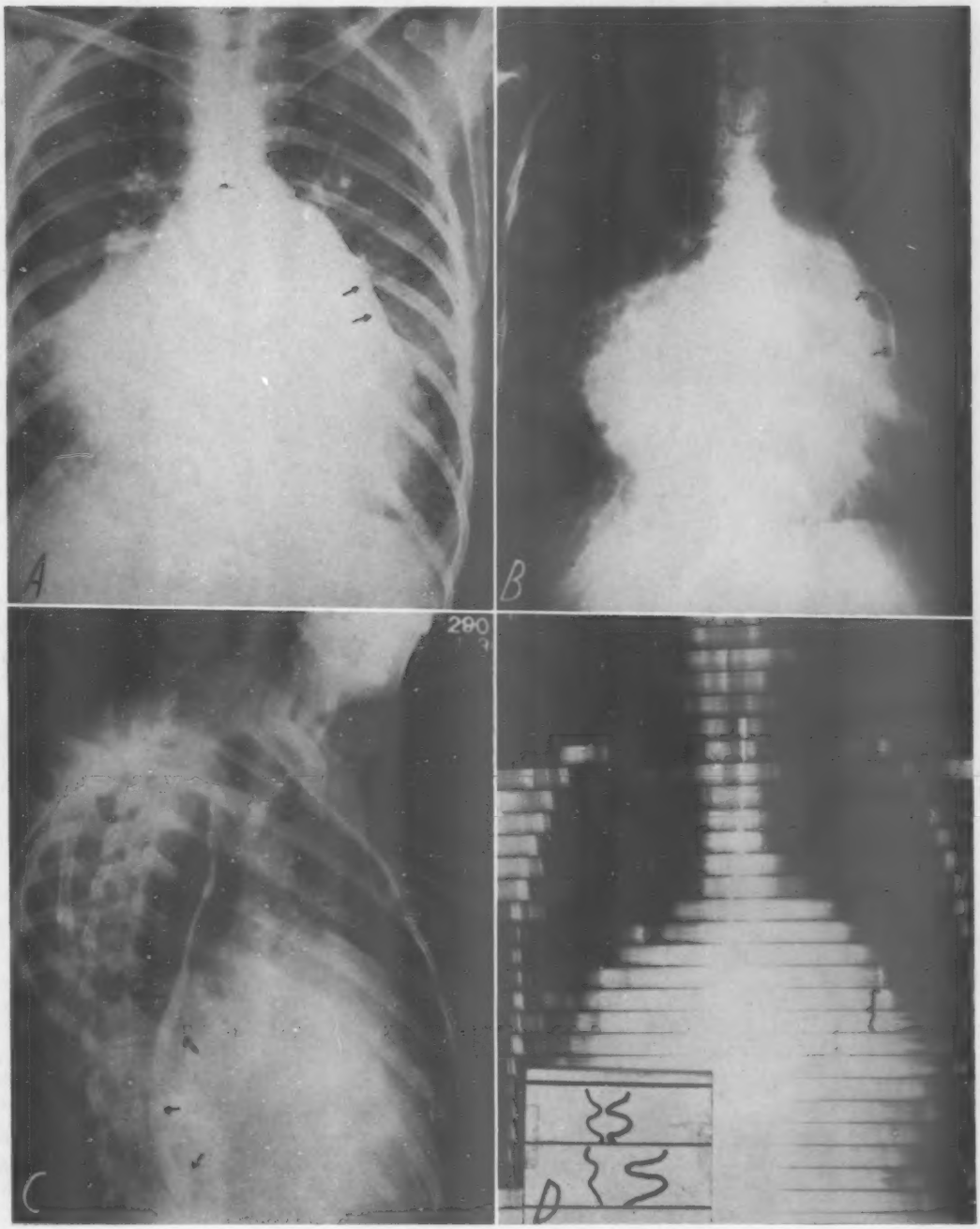


Fig. 2. Case 11. *A*, teleroentgenogram showing faint calcific shadow at midportion of the left heart just within the border (black arrows). *B*, Potter-Bucky roentgenogram of the chest sharply visualizes the calcification in the left lateral aspect of the left atrium. *C*, right anterior oblique roentgenogram. The black arrows indicate the position of the posterior wall of the left atrium in relationship to the barium-filled esophagus. *D*, kymogram. The insert shows the opposing pulsations of the left atrial calcifications and the right ventricle.

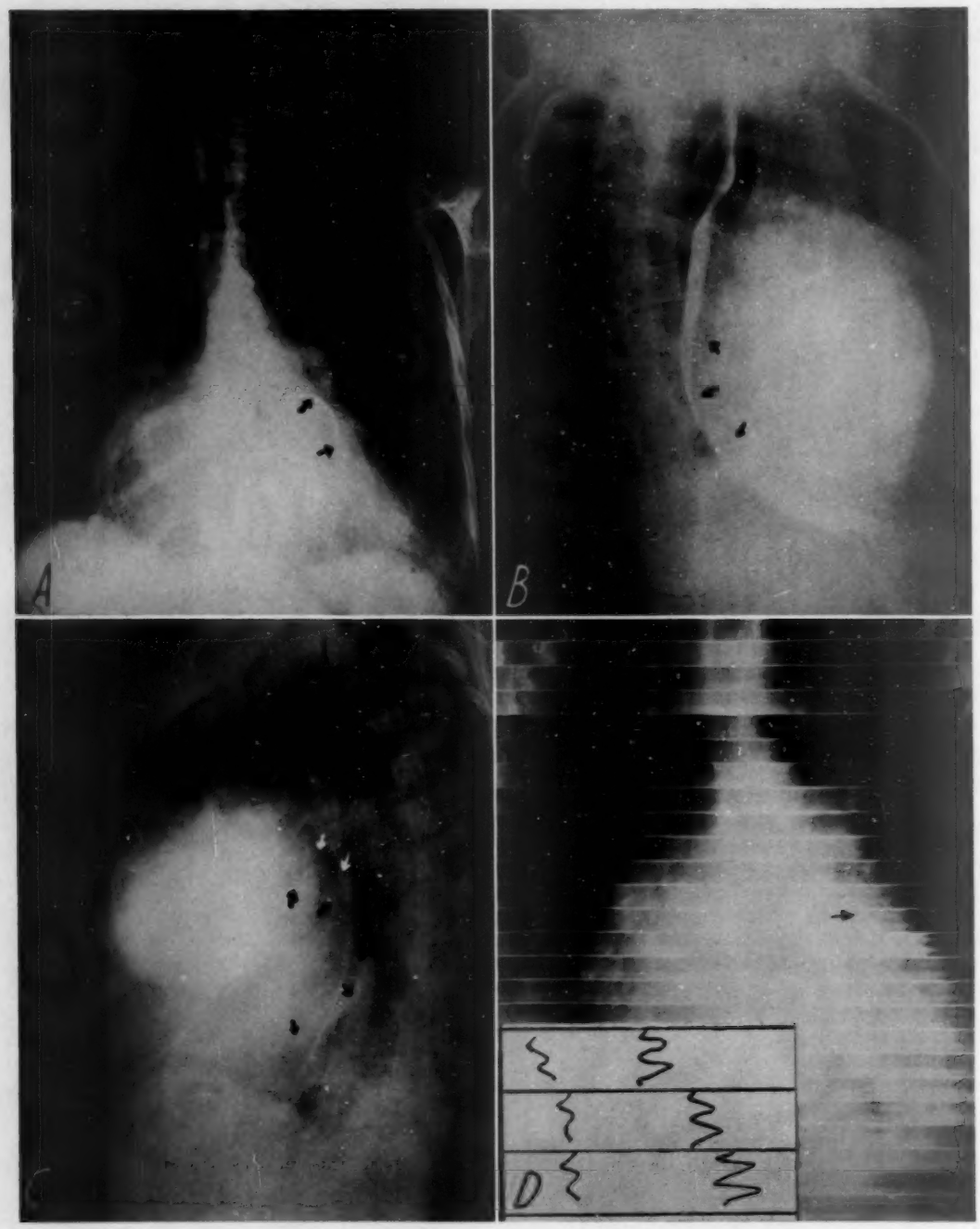


Fig. 3. Case III. *A*, overexposed teleroentgenogram showing left atrial calcification within the heart border. *B*, right anterior oblique roentgenogram. The arrows indicate the position of the posterior wall of the left atrium in relationship to the barium-filled esophagus. *C*, left anterior oblique roentgenogram. The left main bronchus (white arrows) is appreciably separated from the superior aspect of the left atrium (black arrows, upper). The posterior wall is indicated by the lower black arrows. *D*, kymogram. The opposing pulsations of the left atrial calcifications and the right ventricle serve to localize the calcifications.

heaviest deposits were on the posterior and the left lateral walls of the left atrium, and concomitant mitral valve calcifications were seen in 2 of the 3 patients. Begg also noted mitral valve calcifications in his patient. Roentgenologic study in the right anterior oblique position confirms the intimate approximation of the barium-filled esophagus with the posterior aspect of the left atrium, but this close approximation is present only at the point of greatest convexity of the dilated left atrium, giving one the impression that the indentation in the esophagus does not necessarily reflect the exact size of contour of the dilated atrium.

The relative positions of the left heart border and the left side of the left atrium are well demonstrated on these roentgenograms. Previous work on the outline of the heart based on postmortem findings has established the predominantly posterior position of the left atrium,[2,3,7,8] and this has been confirmed by more recent angiocardiographic investigations.[14] It is known that the left atrial appendage may become border forming on the left side of the heart. This structure, however, is of little importance in the reconstruction of the heart silhouette roentgenologically because it is relatively small, flat and contains very little blood. Rarely does the atrial appendage assume any function in the blood-containing capacity of the left atrium, even when the chamber is considerably dilated. It is realized, however, that infrequently the left atrium may become sufficiently dilated to appear on the left heart border.

The location of the calcification seen in the left atriums of the patients reported here reaffirm the fact that with dilatation of the left atrium the left heart border is not reached and that this chamber does not become border forming except in unusual cases.

There was no elevation of the left main bronchus in the 3 cases reported here or in Begg's case, indicating that this sign is not necessarily present with left atrial dilatation.

Differentiation of left atrial calcification from other cardiac calcification should be relatively easy. Valvular lime salt deposits may be identified by their intracardiac position and characteristic movements. Myocardial calcifications usually present an amorphous appearance which may vary considerably in size and position, and in questionable cases kymographic examination may prove helpful in determining the phases of contraction and relaxation of the heart muscle in relationship to the movement of the calcific deposit. Coronary artery calcifications as a rule are linear, small and may be rather difficult to identify. These may be seen in both the frontal and right anterior oblique positions at the left atrioventricular junction. Pericardial calcifications usually occur over the apex, the middle and lower segments of the left heart border or the diaphragmatic surface. When extensive the configuration of the pericardial envelope may be visualized. Fluoroscopic and kymographic examination may reveal diminished or absent cardiac pulsations. Echinococcus cysts of the heart with calcification are uncommon and the pattern would not be confused with left atrial calcifications. Calcification has also been mentioned with tumors of the heart, likewise a rare condition. Extracardiac and aortic calcification may be differentiated by careful fluoroscopic investigation.[12] Laminagraphy may aid in more sharply delineating calcific deposits, and spot roentgenograms are invaluable in making permanent records of fluoroscopic observations. It should be stressed that optimum ocular accommodation is essential, and the use of a small fluoroscopic field is of great assistance. The deposits are better seen roentgenographically on either overexposed films or on films made with a Potter-Bucky diaphragm. If the latter are desired a very short exposure is essential in obtaining adequate definition.

SUMMARY

Three patients with calcification of the left atrial endocardium outlining the cham-

ber to a greater or lesser degree are reported. All three were adult women with rheumatic heart disease and mitral stenosis and insufficiency. The left border of the left atrium was seen in each to be within the heart outline, establishing the fact that with dilatation of the chamber it does not become border forming on the left side of the heart. The impression of the posterior aspect of the dilated left atrium against the barium-filled esophagus in the right anterior oblique projection is due to close approximation of the chamber to the esophagus, but this relationship is present only at the point of greatest convexity of the dilated left atrium. Above and beneath the atrium is separated appreciably from the esophagus. The left main bronchus was not elevated in these three patients and an appreciable space existed between the two structures.

The endocardial left atrial calcifications are presumed to be due to lime salt deposits in MacCallum patches.

1398 Union St.
Brooklyn 13, N. Y.

REFERENCES

1. BEGG, A. C. Calcification of the left auricle. *New Zealand Med. J.*, 1945, *44*, 315–319.
2. DRESSLER, W. Cardiac topography; pathologic studies of anterior aspect of heart and its relationship to the anterior wall of the chest in common heart diseases. *Am. Heart J.*, 1940, *19*, 141–165.
3. EPSTEIN, B. S. Study of the cardiac outline. *Am. Heart J.*, 1936, *12*, 563–572.
4. FRADE FERNANDEZ, M. M., and TORRES RUIZ, A. Total calcification of the left auricle consecutive to an old mural endocarditis. *Medicina*, Madrid (pt. 1), 1944, *12*, 367–373.
5. GRAYZEL, D. M., and LEDERER, M. Metastatic calcification. *Arch. Int. Med.*, 1939, *64*, 136–147.
6. GROSS, L. Lesions of the left auricle in rheumatic fever. *Am. J. Path.*, 1935, *11*, 711–736.
7. HEIM DE BALSAC, R., and ROUTIER, D. Roentgenologic anatomic study of the left auricle following post-mortem opacification. AM. J. ROENTGENOL. & RAD. THERAPY, 1938, *40*, 838–847.
8. KEITH, T. S. The cardiac outline. *Lancet*, 1946, *1*, 1466.
9. MACCALLUM, W. G. Rheumatic lesions of the left auricle of the heart. *Bull. Johns Hopkins Hosp.*, 1924, *35*, 329–336.
10. MACCALLUM, W. G. Rheumatism. *J.A.M.A.*, 1925, *84*, 1545–1551.
11. SHANKS, S. C., KERLEY, P., and TWINING, E. W. A Text-Book of X-ray Diagnosis by British Authors. Vol. I, p. 50. H. K. Lewis & Co., Ltd., London, 1938.
12. SOSMAN, M. C. Technique for locating and identifying pericardial and intracardiac calcifications. AM. J. ROENTGENOL. & RAD. THERAPY, 1943, *50*, 461–468.
13. STEWART, H. J., and BRANCH, A. Rheumatic carditis with predominant involvement and calcification of left auricle; report of a case. *Proc. New York Path. Soc.*, 1924, *24*, 149–163.
14. TAYLOR, H. K., and MCGOVERN, T. Angiocardiography; anatomy of heart in health and disease. *Radiology*, 1944, *43*, 364–372.
15. VON GLAHN, W. C. Auricular endocarditis of rheumatic origin. *Am. J. Path.*, 1926, *2*, 1–14.
16. VON GLAHN, W. C., and PAPPENHEIMER, A. M. Rheumatic disease of auricle and blood vessels. *Tr. A. Am. Physicians*, 1928, *43*, 203–212.

VOL. 61, NO. 2

A CASE OF BRONCHIAL ADENOMA WITHOUT SIGNS OF BRONCHIAL OBSTRUCTION, CONCOMITANT WITH MINIMAL PULMONARY TUBERCULOSIS

By CAPTAIN GILBERT H. FLETCHER
Medical Corps, Army of the United States
and
MARION S. LOMBARD
Medical Director, Marine Hospital, Pittsburgh, United States Public Health Service

ABOUT two hundred cases of bronchial adenoma have been reported and several articles have been published treating the subject exhaustively. In all but a few instances some evidence of partial or complete bronchial obstruction existed. This case with no evidence of obstruction and the concomitant presence of a minimal tuberculosis created a difficult diagnostic problem which justifies recording.

CASE REPORT

A. M. R., white female, aged forty-six, came to the Outpatient Department of the U. S. Marine Hospital, Pittsburgh, Pennsylvania, on January 25, 1946, complaining of recent weight loss, chronic cough with yellowish sputum, occasional night sweats, pain in the chest, and one hemoptysis. Her mother had died a year previously of cancer. Her past history revealed right chronic mastoiditis and attacks of pain in the right upper quadrant of the abdomen, but nothing related to the respiratory organs; particularly, there were no repeated attacks of pneumonia. Physical examination of the chest was negative.

Stereoscopic films taken on January 26, 1946, showed small, sharply circumscribed, partially calcified areas of infiltration in the periphery of the second left interspace. The remaining portions of the lung fields were considered negative. The impression of the roentgenologist was that the lesion seen was apparently arrested and did not account for the hemoptysis. Close follow-up was advised. A blood count showed a moderate anemia, normal leukocyte count, and a sedimentation rate of 13 mm. Repeated sputum examinations were consistently negative; serial roentgenograms showed no change. During this period the patient felt essentially the same and continued to have occasional blood-streaked sputum. In June, 1946, on a roentgenogram (Fig. 1) inadvertently taken with a heavier technique than those taken previously, there was an area of infiltration about 1.5 cm. in diameter, somewhat rounded, not too clearly defined, seen about 5 cm. under the right hilum and partially overlapped by the right cardiac border. On the right lateral view the infiltration was thought to be below the hilum back to the

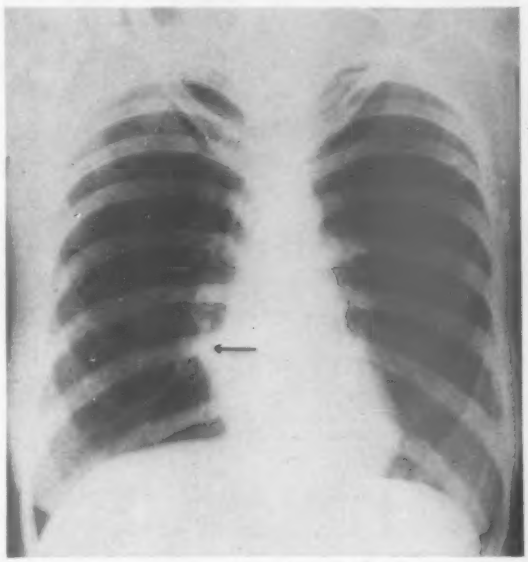


FIG. 1. Posteroanterior roentgenogram taken in June, 1946. One sees the small well defined areas of infiltration in the left upper lobe. There is at the apex of the angle made by the posterior aspect of the ninth right rib and the right cardiac border an area of infiltration about 1.5 cm. in diameter, somewhat rounded, not too clearly defined, partially overlapped by the cardiac border and the rib. The right lower and right middle lobes are entirely clear and there is no emphysema. (See arrow.)

fissure between the right middle and right lower lobes (Fig. 2). Neither of these lobes showed any evidence of obstructive emphysema, atelectasis, bronchiectasis, or chronic pneumonitis.

A review of the previous roentgenograms revealed that this infiltration had been overlooked and that it had not changed since January, 1946. Because of the nodular appearance, the stability and the location at the usual site of the contralateral spread of tuberculosis, it was thought that the area probably represented a nodular tuberculous infiltration, but since this type of tuberculous lesion is notoriously benign and not apt to produce hemoptysis, the possibility of a tumor was considered. At this

FIG. 2. Right lateral view. Below the hilum, back to the fissure between the right middle and right lower lobes is seen the area of infiltration. The right base is completely clear. (See arrow.)

time the patient ran a slight afternoon temperature and had a flare-up of the symptoms in the right upper quadrant.

She was admitted to the Marine Hospital. Several sedimentation rates ran between 10 and 15 mm.; the red blood cell counts were around 4 million with normal leukocyte counts and differentials. Sputum and gastric washings examined by smear, culture, and guinea pig inoculation were all negative for acid fast bacilli. A tuberculin test performed with 0.005 mg. Tuberculin Purified Protein Derivative was mildly positive. During her hospital stay the patient gained weight and her temperature returned to normal. On several occasions without apparent effort she brought up bright red blood from her mouth. Repeated chest examinations showed no change in either the minimal infiltration of the second left interspace or the somewhat nodular infiltration below the right hilum.

In view of this persistent hemoptysis and the failure to demonstrate any active tuberculosis, the probability of a tumor was more seriously considered. On October 8 a bronchoscopy was done and the larynx, trachea, and bronchial mucosa seemed to be a deeper pink than they would appear normally. There was no edema, ulceration, suppuration, or neoplasms throughout the tracheobronchial tract. It was suggested that if the symptoms persisted, another bronchoscopy be done.

The patient was then referred to the Tumor Clinic of the U. S. Marine Hospital, Baltimore, Maryland, where another bronchoscopy was performed. The following findings were seen: Approximately 3 to 3½ inches from the carina, the right lower lobe bronchus appeared to be narrow, and immediately in front of the bronchoscope was visualized a rounded purplish mass which bled easily. The remainder of the bronchoscopy was negative. A biopsy was taken from the mass with the subsequent histopathological diagnosis of a bronchial adenoma. The patient was operated upon and a right lower and right middle lobectomy was performed. On the operative specimen, between the bronchus and the large vessel in the hilar region, there was a grossly lobulated yellow-gray tumor mass approximately 1.5 cm. in diameter. There was definite infiltration of the bronchial wall at the division of the right lower and right middle lobe bronchi. Microscopic examination showed rather circumscribed collections of basophilic cells in a scanty and loose fibrous stroma. These cells, which were uniform, exhibited indefinite cytoplasmic limits and deep staining nuclei of variable shapes. Each area of tumor had a compressed fibrous capsule. In one of the sections lung tissue was seen, and there was a localized area of fibrosis, necrotic in the center with infiltrated lymphocytes and compression of the lung parenchyma. The bronchial wall in some parts was edematous and contained collections of lymphocytes. The bronchial mucosa appeared normal. Pathological diagnosis: Adenoma of the bronchus.

COMMENT

Polypoid tumors of the bronchi produce bronchial irritation, partial or total obstruction, and bleeding. In these features

reside the explanation of the clinical and roentgenological picture. Consequences of slowly increasing bronchial obstruction are in almost all instances the predominant components of bronchial adenoma. Repeated attacks of pneumonia, obstructive emphysema, chronic pneumonitis, abscesses, atelectasis, and pulmonary fibrosis are usually present, alone or in various combinations.

In this case repeated slight hemoptysis, some cough, and apparently stable areas of infiltration were the only findings. As the infiltration of the left upper lobe was obviously tuberculous, the most likely diagnosis was tuberculosis with probable bronchial involvement to account for the hemoptysis. A tumor was considered the second choice. Undoubtedly, if there had been signs of bronchial obstruction in the segments distal to the right lower lobe with its nodular infiltration, the diagnosis of a tumor would have then been the diagnosis of choice.

Gilbert H. Fletcher, M.D.
University of Texas
M. D. Anderson Hospital
Houston, Texas

REFERENCES

1. Adams, W. E., Steiner, P. E., and Bloch, R. G. Malignant adenoma of the lung; carcinoma-like tumors with long clinical course. *Surgery*, 1942, *11*, 503–526.
2. Brunn, H., and Goldman, A. Differentiation of benign from malignant polypoid bronchial tumors. *Surg., Gynec. & Obst.* 1940, *71*, 703–722.
3. Clerf, L. H., and Bucher, C. J. Adenoma (mixed tumor) of bronchus; study of 35 cases. *Ann. Otol., Rhin. & Laryng.*, 1942, *51*, 836–850.
4. Lowry, Thomas, and Rigler, L. G. Adenoma of the bronchus; clinical and roentgenologic study with report of seven cases. *Radiology*, 1944, *43*, 213–229.

INTRALUMINAL DIVERTICULUM AND OTHER LESIONS PRODUCING INTERMITTENT DUODENAL OBSTRUCTION OR STASIS

By RICHARD E. KINZER, M.D.
DIXON, ILLINOIS

MORE and more attention is being given to the study of the small intestine. Improved methods for the examination of the jejunum and ileum include the fractional barium meal and intestinal intubation. These methods of examination have increased the diagnostic accuracy in the study of the small intestine. However, the radiologist should not consider the small intestine as a blind spot in the routine gastrointestinal series. It is rarely necessary to subject the patient to intestinal intubation in order to obtain an adequate study of the duodenum and jejunum. Routine examination of the stomach should always include one or more emptying films, and close attention to the passage of the barium meal through the duodenum and jejunum during roentgenoscopy should be considered an essential part of the examination.

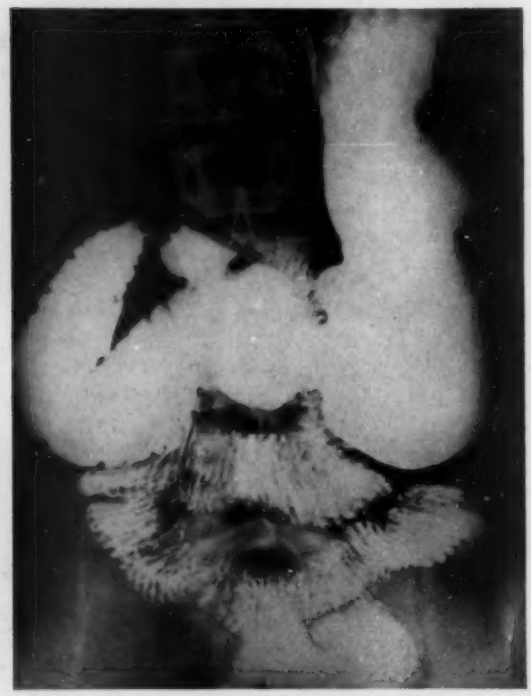


FIG. 1. Arteriomesenteric occlusion of the transverse duodenum. The patient's colon and other organs were located quite low in the abdomen.

Extrinsic lesions producing deformity of the duodenum are relatively common. In our search for small intestinal pathology, we are more likely to find disease in other organs than in the intestine. This is particularly true of the second and third parts of the duodenum because of their intimate relationship with several neighboring structures. Brown and Harper[2] have recently

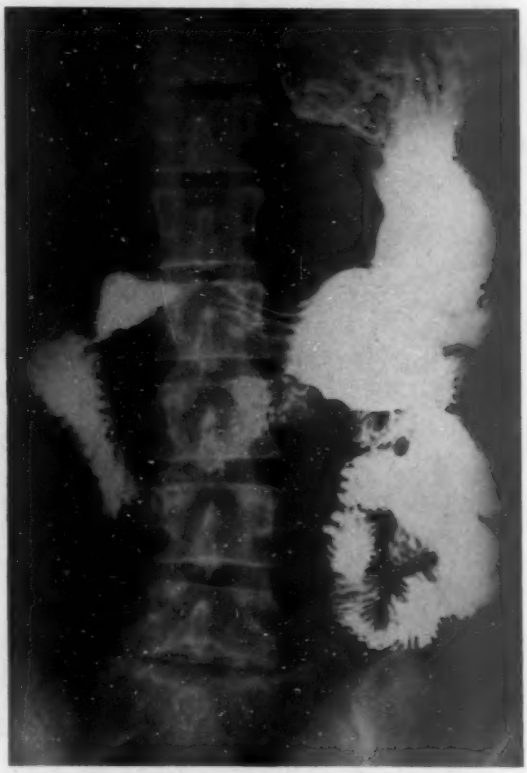


FIG. 2. Carcinoma of the pancreas. Metastatic glands at the root of the mesentery produced the stasis shown in this roentgenogram.

called attention to the importance of studying the duodenum in cases of extrahepatic biliary tract disease. They have found compression of the superior flexure of the second part of the duodenum a valuable sign in differentiating obstructive and nonobstructive jaundice.

Dilatation and stasis, confined to the first and second parts of the duodenum and the right half of the transverse duodenum, are characteristic of arteriomesenteric occlusion of the duodenum. The transverse portion of the duodenum is dilated on the right side of the spine and normal on the left side. This type of stasis is usually associated with generalized visceroptosis and should be suspected in individuals of the hypersthenic type who complain of nausea, pain in the epigastrium, and vomiting. Figure 1 illustrates this condition. The duodenal distention has caused some loss of the connivental markings in the descending part of the duodenum, although there is not an appreciable enlargement of the duodenal cap.

Pressure from an adjacent organ is perhaps more common than visceroptosis in the production of duodenal stasis. Because of its position, the pancreas is most likely to be the source of the pressure. Lesions of the head of the pancreas may produce the characteristic wide duodenal sweep and pancreatic carcinomas which metastasize to regional mesenteric glands can produce duodenal stasis much like that seen in arteriomesenteric pressure deformities of the duodenum. Figure 2 illustrates duodenal stasis secondary to carcinoma of the pancreas in a white female, aged thirty-five. A large sweep around the head of the pan-

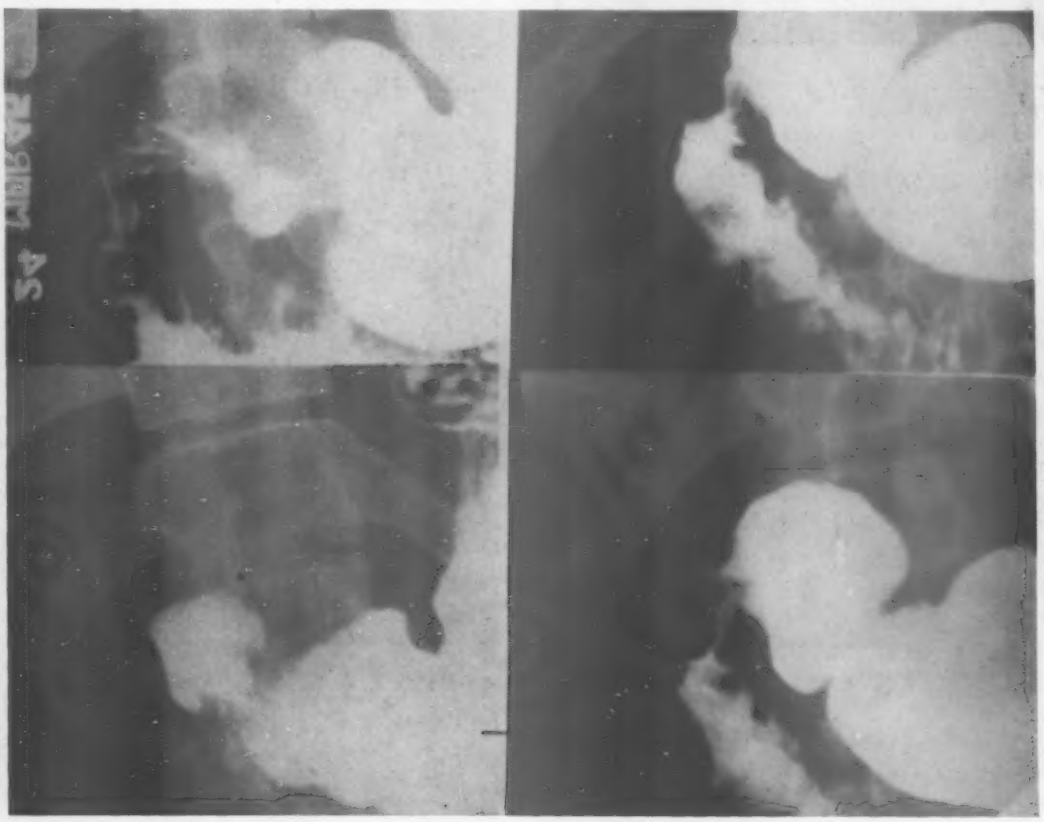


Fig. 3. Duodenal ulcer involving the lesser curvature of the second part of the duodenum. This patient was extremely refractive to all forms of medical management.

Fig. 4. Acute stomal ulcer at the site of an ancient gastrojejunostomy. This gastroenterostomy had functioned normally for twenty-five years.

creas is apparent, but the duodenal stasis seems to end at the vertebral border. The stasis was caused by metastatic glands at the root of the mesentery.

Intermittent obstruction and stasis are among the most common disorders seen in the distal portions of the duodenum, and if not due to extrinsic pressure may be the result of intrinsic pathology. Frequently, the first roentgenoscopic evidence of duodenal stasis is a dilated duodenal cap. If the distal loops of the duodenum are not dilated in the presence of megabulbus, careful attention to the descending loop of the duodenum may reveal acute ulceration. Figure 3 illustrates an active ulcer crater on the lesser curvature of the second part of the duodenum. Slight enlargement of the duodenal cap can be noted. There was a twenty-four hour gastric retention of almost 80 per cent of the barium meal.

Jejunal ulcers following gastrojejunostomy are relatively common. In some cases, these ulcers may cause sufficient spasm, or enough adhesions may form, to produce duodenal stasis or actual jejunal obstruction. Figure 4 shows an extremely dilated duodenum secondary to acute stomal ulceration at the site of an old gastrojejunostomy. This stasis was largely due to spasm, but surgical intervention was necessary to relieve the symptoms.

Foreign bodies occasionally obstruct the duodenum. Both tapeworms and roundworms have been responsible for obstructtion in this area. Toys and other foreign bodies swallowed by children either remain in the stomach, or if passed into the bowel, usually proceed on through the intestines and are eliminated. Figure 5 illustrates an unusual partial obstruction of the second part of the duodenum produced by a surgical sponge. The patient had sustained a gun-shot wound through the upper right abdomen which had perforated the duodenum. The lesion was repaired, and what seemed to be a good result was obtained. Several months later symptoms of partial

Fig. 5. Surgical sponge in the duodenum. Note surrounding inflammatory mass.

obstruction with elevation of temperature appeared. There was pain and tenderness in the epigastrium and on roentgen examination it was apparent that there was an inflammatory process in the region of the pancreas and second part of the duodenum. A laparotomy was performed and adhesions about the duodenum were freed. The bowel was not opened. Temporary relief was obtained, but after several weeks of observation it was necessary to operate again for relief of obstructive symptoms. The bowel was opened on this occasion and a surgical sponge was removed. Recovery was then uneventful.

Diverticula of the duodenum are quite common. They are most often seen on the lesser curvature of the second and third parts of the duodenum. They are not often symptomatic. They may be multiple and are frequently quite large. Both perforation and bleeding have been reported. Figure 6 shows an example of multiple diverticula of the duodenum in a patient who had a large esophageal hiatus hernia. In this case, the diverticula were completely asymptomatic, but the esophageal hiatus hernia was causing moderate epigastric distress. Some authors[6] believe that diverticulosis of the small intestine may produce epigastric distress possibly as a result of retention in the sacs. Edema and local swelling could conceivably produce stasis in the intestine.

Fig. 6. Multiple diverticula of the duodenum in a patient with an esophageal hiatus hernia.

Fig. 7. Megaduodenum secondary to partial obstruction at junction of first and second parts of duodenum. Whether this obstruction is due to a partial intrinsic stenosis or to an extrinsic fibrous band is not known.

Megaduodenum may be secondary to vestigial intrinsic duodenal diaphragm.[3] These embryonic rests are quite rare and are seldom seen in adults. Duodenal obstruction in the newborn is still almost uniformly fatal although early diagnosis and surgery have recently begun to reduce the mortality.[4,5] Figure 7 is a roentgenogram of an adult white male who has a megaduodenum with an apparent partial stenosis or

perforate diaphragm at the junction of the first and second parts of the duodenum. Repeated roentgenoscopic examinations have failed to show any extrinsic pressure deformity and the partial obstruction is almost certainly intrinsic in origin. Although symptoms of distention and malnutrition have existed for years, the patient refuses surgical intervention and a more positive diagnosis has therefore been impossible.

Fig. 8. Case report. Roentgenogram made one hour after barium meal showing "gourd-like" sac in descending duodenum.

Intraluminal diverticulum of the duodenum has apparently not previously been reported. Bockus does not mention this condition.[1] An instance of intermittent duodenal obstruction produced by an intraluminal diverticulum, and proved surgically, is presented.

CASE REPORT

R. S., a white male, aged twenty-two, was admitted to an Army hospital feeling quite well. He gave a history of having had an acute attack of upper abdominal pain with vomiting and subsequent diarrhea while overseas on duty with the Armed Forces. A gastrointestinal examination at the time was reported as follows: "Duodenal obstruction probably secondary to extrinsic pressure." On careful questioning the patient admitted that he had had many previous episodes of nausea, vomiting, and diarrhea over a period of many years. The first attacks occurred in early childhood. Recovery from previous attacks had usually taken place in two or three days with no particular treatment except bed rest. Physical examination and routine laboratory examinations were negative. Roentgenoscopic examination of the stomach revealed a megabulbus, but the distal part of the duodenum seemed quite normal. A film made one hour after the barium meal showed a gourd-like structure, partially filled with barium, in the descending duodenum. Subsequent films failed to demonstrate the structure again, and in five hours the stomach and duodenum were empty. After a few days the examination was repeated. The duodenal bulb was greatly dilated and as barium entered the descending duodenum it was seen to fill a sac-like structure which enlarged and completely obstructed the duodenum. It was impossible to force any of the barium beyond this point. After manipulation and palpation, the sac was emptied by milking the contents back into the stomach. After emptying of the sac, barium was seen to pass around it and proceed on through the distal loops of the duodenum in normal fashion. A diagnosis of intraluminal diverticulum of the duodenum was made. Surgical exploration confirmed the roentgen diagnosis. The sac was found to have a mucosal lining on both the inside and outside. It was possible to invert the sac in the manner of turning the fingers of a glove inside out. The mouth of the sac was located just distal to the vaterian area. Figures 8, 9, 10 and 11 illustrate the roentgen findings.

COMMENT

Duodenal obstructions are seen in all age groups. Those occurring in early life are usually due to congenital malformations. These malformations may be intrinsic or extrinsic in nature. They are called intrinsic when the obstruction is due to a perforate or imperforate diaphragm, when partial or subtotal stenosis is present, and when there is an atresia.[4] Figure 7 illus-

Fig. 9, 10. Case report. Spot roentgenograms in anteroposterior and right lateral projections showing intrinsic diverticulum well filled with barium and completely obstructing duodenum.

trates a case which falls in the group of intrinsic obstruction due to a partial stenosis. This patient has refused surgery and has shown some improvement on medical treatment. Nine cases of intrinsic duodenal diaphragm have been reported in the literature.[3] This persistent structure is a result of incomplete recanalization of the fetal duodenum. During early fetal life the duodenum becomes completely obliterated by epithelial proliferation. At this stage in development, the pancreatic and hepatic ducts are being formed.[4] Normally, the duodenum is then recanalized and complete re-establishment of the duodenal lumen takes place. It seems logical to assume that an intrinsic diverticulum in the duodenum could result only secondary to

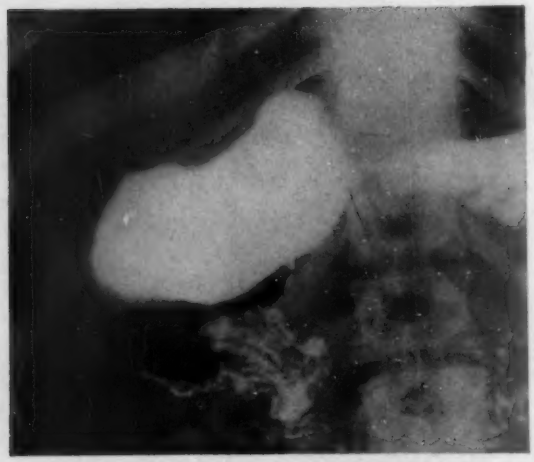


FIG. 11. Case report. Spot roentgenogram of partially evacuated sac showing presence of mucosal folds. After evacuation of the sac, barium passed around the diverticulum and proceeded normally through the bowel.

some remnant of a duodenal diaphragm. Our patient's history of intermittent obstruction in early life would seem to indicate that his duodenal deformity was congenital in nature.

SUMMARY

1. Duodenal obstruction and stasis have been discussed, and several of the more common causes have been presented and illustrated.

2. A case of intraluminal diverticulum of the duodenum, producing intermittent obstruction, is presented.

Dixon, Ill.

REFERENCES

1. BOCKUS, HENRY L. Gastro-Enterology. W. B. Saunders Company, Philadelphia, 1944.
2. BROWN, S., and HARPER, F. G. A new roentgen sign in extrahepatic biliary tract disease. *Radiology*, 1946, *47*, 239–248.
3. DRUCKER, V., and COHEN, E. S. Megaduodenum secondary to an intrinsic duodenal diaphragm. AM. J. ROENTGENOL. & RAD. THERAPY, 1946, *55*, 726–729.
4. KAUTZ, F. G., LISA, J. R., and KRAFT, E. Congenital duodenal obstruction. *Radiology*, 1946, *46*, 334–342.
5. KRIEG, E. G. Duodenal diaphragm. *Ann. Surg.*, 1937, *106*, 33–41.
6. RITVO, M., and VOTTA, P. J. Diverticulosis of the jejunum and ileum. *Radiology*, 1946, *46*, 343–349.

THE ROENTGEN MANIFESTATIONS OF PANCREATITIS COMPLICATING MUMPS

By M. H. POPPEL, M.D., F.A.C.R., *and* CELIA BERCOW, M.D.
NEW YORK, NEW YORK

IN PREVIOUS papers on the roentgen manifestations of pancreatic conditions mumps could only be mentioned and illustrated briefly. It is the purpose of this paper to enlarge upon the subject.

Mumps is a general, specific, infectious disease with characteristic localization in the parotid and other salivary glands. Among the common complications are orchitis, oophoritis and mastitis.

Accompanying some of the typical cases is a clinical syndrome which is characteristic of pancreatitis, either in the acute or subacute form. The latter is the more common form. The condition is rarely serious.

In the acute form there may be high fever, nausea, vomiting, severe pain over the epigastrium and left hypochondrium with radiation towards the back, developing some prostration usually, but not always, about one week after the onset of the parotid swelling. The urine may contain sugar. On physical examination there is tenderness over the pancreas with some overlying muscular rigidity.

In other cases the pancreatitis is mild with only a slight to moderate degree of the above symptoms and signs.

The pathological changes are:

1. Gross
   (a) swelling of the pancreas with redness.
   (b) enlargement with congestion of the adjacent lymph nodes.
2. Microscopic
   (a) congestion of the blood vessels.
   (b) edema and swelling of the cells of the external secreting glands, as well as of the islet cells.
   (c) cellular infiltrations, chiefly mononuclear, occur.

ROENTGEN STUDY

The roentgen examination consists of roentgenoscopy, simple preliminary films and barium meal study.

The roentgen signs of acute pancreatitis are:

Marked intolerance to barium in the duodenal loop with or without enlargement and displacement of the loop. The loop is so irritable that it is difficult to visualize any barium therein. It resembles the intolerance seen in the Stierlin phenomenon in cecal tuberculosis.

Elevation of the stomach.

Restricted motion or freezing of the left diaphragmatic dome.

Transverse position of the duodenal bulb with or without enlargement of the duodenal loop.

Collection and stasis of appreciable quantities of contrast material in the dependent portions of the duodenum.

Fullness between the transverse colon and the stomach.

Ill defined left psoas muscle contour.

Pressure indentations on the stomach and duodenum.

Coarsely feathered duodenal mucosal relief, possibly due to edema.

Abnormal gas distention of the colon, especially the transverse portion, and even a paralytic ileus with the formation of fluid levels when the patient is examined in the erect or lateral recumbent posture.

The roentgen manifestations of the subacute forms may vary from no demonstrable manifestation to slight or moderate degree of the manifestations described under the acute form.

INCIDENCE

Ninety-five (65 male and 30 female) con-

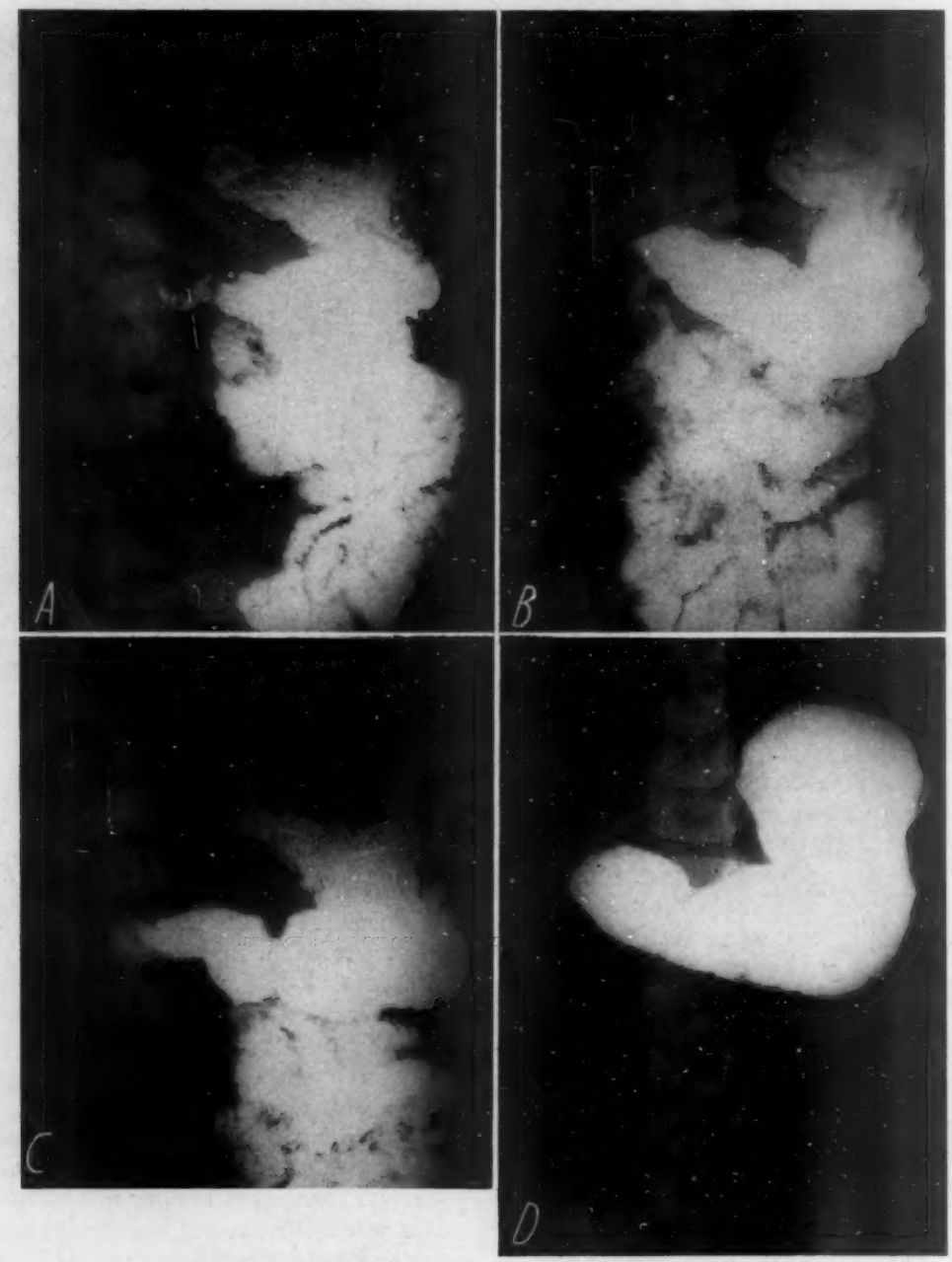


FIG. 1. *A, B, C, D.* Case 1. Elevation of stomach and bulb; marked duodenal intolerance to the barium sulphate.

secutively diagnosed cases of mumps in patients up to the age of thirty were available for study. Of these, 17 (15 male and 2 female) had signs and symptoms referable to the pancreas and were classified clinically as follows: acute pancreatitis, 3 (2 male and 1 female) and subacute pancreatitis, 14 (13 male and 1 female).

The 3 acute and 11 of the 14 subacute cases were roentgenographed. All 3 of the acute cases, in patients four, nine and ten years of age, were definitely positive. Of the

11 subacute cases roentgenographed, 4 were normal and 7 showed positive findings.

The 3 acute cases (Fig. 1, 2 and 3) and 1 of the typical subacute positive cases (Fig. 4) are herein described. No special sequence nor interrelationship with the other more common complications was discernible.

CASE REPORTS

Case 1. The patient, male, aged four, vomited twice and refused food on the sixth day following the onset of parotid mumps. The tempera-

Fig. 2. Case II. Moderate duodenal intolerance to the barium sulphate; coarsening of the duodenal mucosa.

ture was 104° F. There were no other complications. The roentgenoscopic and film studies (Fig. 1) revealed marked duodenal intolerance to the barium sulphate, with pancreatic tenderness roentgenoscopically. The stomach and bulb were elevated. The movement of the left

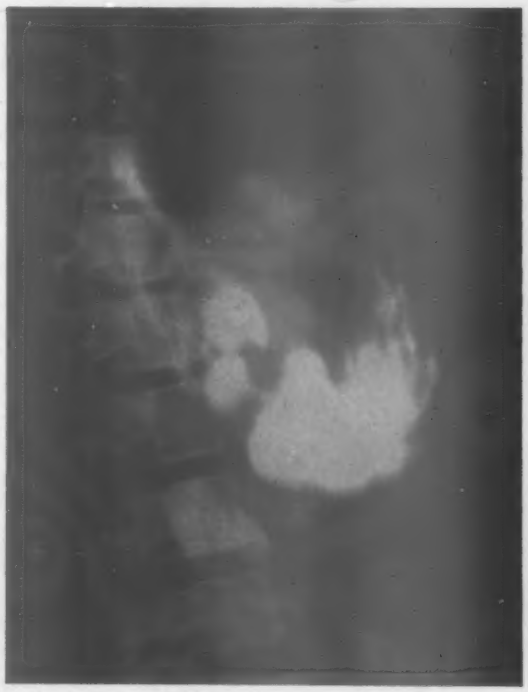


Fig. 3. Case III. Marked duodenal intolerance to the barium sulphate.

Fig. 4. Case IV. Moderate duodenal intolerance to the barium sulphate.

diaphragm was restricted. The duodenal loop was not perceptibly enlarged.

CASE II. The patient, male, aged ten, complained of epigastric pain eight days after the onset of parotid mumps. There was nausea and vomiting. The temperature was 103° F. There were no other complications. The roentgenoscopic and film studies (Fig. 2) were similar to the above except that the duodenal intolerance to barium was not as marked. This permitted visualization of the duodenal mucosa, which was coarsened.

CASE III. The patient, female, aged nine, complained of pain in the epigastrium and left hypochondrium beginning six days after the onset of parotid mumps. The temperature was 102.2° F. There were no other complications. There was loss of appetite and slight nausea but no vomiting. The roentgenoscopic and film studies (Fig. 3) revealed marked duodenal intolerance to the barium sulphate and pancreatic tenderness roentgenoscopically. The duodenal loop was not enlarged.

CASE IV. The patient, male, aged thirty, complained of vague mid-abdominal and back pain ten days after the onset of parotid mumps. The temperature was 100° F. There was continued slight nausea and anorexia but no vomiting. The roentgenoscopic and film studies (Fig. 4) revealed to a slight degree the signs described under the acute cases. The most constant roentgen finding was moderate duodenal intolerance to barium. There was no tenderness and no enlargement of the duodenal loop.

114 East 54th St.
New York 21, N. Y.

REFERENCES

1. CASE, J. T. Roentgenology of pancreatic disease. AM. J. ROENTGENOL. & RAD. THERAPY, 1940, *44*, 485–518.
2. CECIL, R. L. A Textbook of Medicine. W. B. Saunders Co., Philadelphia, 1931, pp. 296–300.
3. POPPEL, M. H. Lesions of the pancreas. In: Clinical Radiology. Edited by G. U. Pillmore. F. A. Davis Co., Philadelphia, 1946, Vol. I, pp. 660–697.
4. POPPEL, M. H., and MARSHAK, R. H. Roentgen diagnosis of pancreatic disease. AM. J. ROENTGENOL. & RAD. THERAPY, 1944, *52*, 307–316.
5. RENDICH, R. A., POPPEL, M. H., and COVE, A. M. Roentgen diagnosis of space-occupying lesions in the region of the head of the pancreas. *Radiology*, 1942, *38*, 47–52.

DEMONSTRATION OF SINUS TRACTS, FISTULAS, AND INFECTED CAVITIES BY LIPIODOL*

By MAJOR JAMES M. DELL, Jr.
Medical Corps, Army of the United States

THE purpose of this paper is to present the technique of the injection of sinus tracts, fistulas, and infected cavities. The justification is the scarcity of literature on this subject, the fact that by the information gained curative procedures are instituted at an earlier date, and that the surgeon explores with preoperative knowledge of the extent and direction of the disease process.

One of the few articles in the literature is that by Gage and Williams[1] of the Radiological Department, St. Mary's Hospital, London, England. This article was of such exceptional merit that it was republished in full in *Radiology*. It will be quoted freely in this paper.

A sinus is a tract leading from the skin or mucous membrane to a deep-seated focus of suppuration, a vestigial structure, or an aberrant secreting tissue.

* From the Battey General Hospital, Rome, Georgia.

[1] Gage, H. C., and Williams, E. R. Radiological exploration of sinus tracts, fistulae and infected cavities. *Radiology*, 1943, *41*, 233–248.

Fig. 1, *A* and *B*. Case 1. This illustrates a cavity in bone filled by the replacement method. The sinus had drained for six months. Very little evidence in the plain film. Very small opening in the skin. A few minims of lipiodol were injected and the pressure was too great for further injection. The syringe was removed and pus exuded. This was repeated twelve times with the heavier lipiodol sinking to the bottom and displacing the pus. At operation a large cavity as shown was unroofed, and in a few weeks the patient's drainage stopped.

Fig. 2. Case IV. A Y shaped sequestrum with five sinus tracts leading through bone to skin openings. Four of these openings had to be plugged. It is readily apparent in this case that the operative approach can be planned so that the continuity of bone is not completely interrupted. If the operation is not planned with this in mind, a fracture may occur which in this sclerotic bone may result in non-union or in marked delay in union. Operative removal of the sequestrum was performed. No drainage now for three months.

A fistula is an abnormal tract leading from a mucous surface to another mucous surface or to the skin.

The walls of chronic sinuses are made up of fibrous tissue lined by granulation tissue which constantly produces pus. In very long standing sinuses and fistulas there is usually a down growth of epithelium from the skin or mucous surface which may become complete and prevent closure of the abnormal tract.

Persistent tracts are due to: first, and most important, the presence of sequestra or foreign bodies; second, inadequate drainage; third, epithelization of the tract.

Generally speaking, the principles of treatment of sinuses and fistulas are two in number. First, the necrotic or foreign material must be removed and adequate drainage provided. Second, if the tract persists after removal of the cause, then the tract must be removed or destroyed.

The injection and roentgenological demonstration of sinus tracts, fistulas, and abnormal cavities is by no means simple. The prime requisite is to have the sides of the injection mechanism tightly applied to the walls of the tract and still have the tip free, that is not in contact with the underlying structures. This has been the main problem as we have met with every conceivable type of opening. The pin-point opening is injected best by an ordinary No. 20 gauge needle with the shaft cut off near the base. As this has a sloping smooth enlargement from tip to base with a smooth blunt tip it is more efficient than the lacrimal duct cannula advocated by Gage and Williams. For a slightly larger opening the shaft is pulled out of the base with a pair of pliers. We do not have the special conical rubber adaptor nozzle used by Gage and

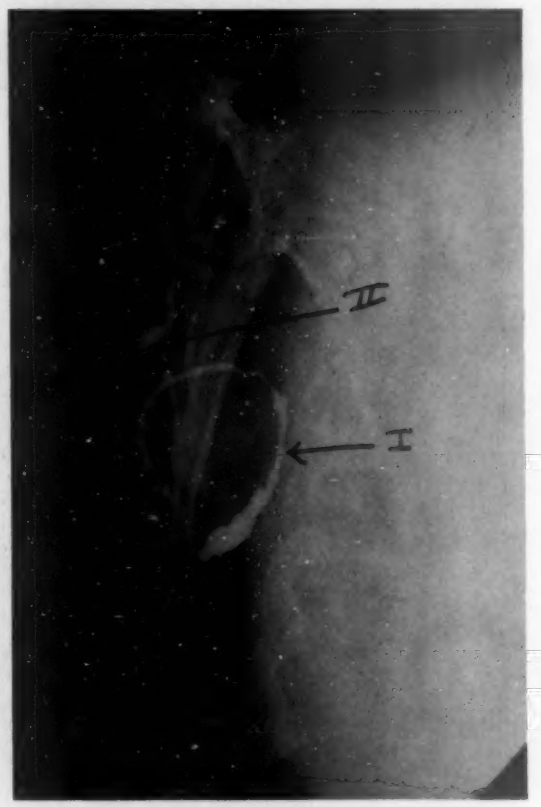


Fig. 3. Case V. (*I*) A long curving tract ending in a surface defect in bone near the lower angle of the scapula. (*II*) A second tract leading along a surface defect on the posterior surface of the scapula. Both tracts are inadequately drained.

Williams, but have used an improvised one which has certain advantages, namely, the tip lies away from the end of the rubber adaptor. These are easily made from the stoppers used on nearly all standard rubber capped vials. The stopper is inverted and a hole cut in the part that projected into the vial. This is pulled up on the metal adaptor of an ordinary syringe. This has made injection of tracts possible when other methods have failed.

A second improvised injector that has been of value is made from the rubber cap of a medicine dropper. The open end is cut off and an opening made in the closed end. These openings are of various sizes and are slipped over either the needle base or the metal adaptor of a syringe. This gives an efficient conical rubber injector. Telescoping or fitting one of these dropper caps into another and slipping them over the needle base or metal adaptor makes a pliable injecting mechanism with a protected tip which can be used to advantage.

Injection through an inserted catheter is necessary in some of the gaping wounds. The danger in this is that a superficial tract may be by-passed. I believe that the ideal injecting mechanism for a number of the openings would be one suggested by Colonel Faust of this station. This utilizes cannulas of various sizes threaded through solid rubber balls of various sizes. If these were available, lipiodol injection would be very much simplified in some cases. After insertion of the injecting mechanism, if the injection is difficult, the tip is tilted up, down, or to the side. It is necessary in

Fig. 4. Case vi. A cavity between fragments with tracts leading into a large cavity in the head of the femur. Operation—Multiple small hard fragments of bone found in a cavity in the head and neck. Cavity admitted a finger and was smooth walled.

Fig. 5. Case vii. A chronic bone abscess not the result of trauma. Drainage of seven months' duration. Very difficult to inject. The tip would always strike an obstacle that would plug it. Shifts of position would not allow injection. Only by using a protected tip could the injection be done and then only by using marked pressure alternation with suction. There must have been a piece of tissue acting as a ball valve with obstruction to the inflow as this cavity was draining freely. At operation the cavity was unroofed and curetted. Much dirty granulation tissue was removed. This lesion was supposedly secondary to a gonococcal arthritis of the knee.

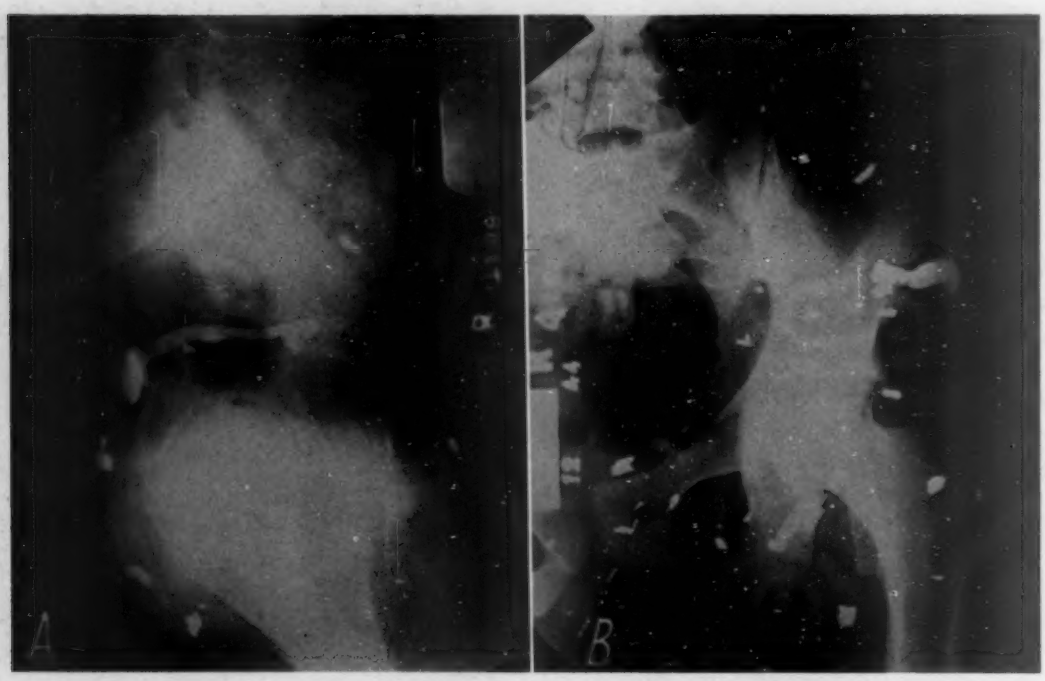


Fig. 6, *A* and *B*. Case ix. Plain film revealed a cavity in the left ilium containing a metal fragment. This was evident as the cause of drainage. Lipiodol injection was needed to rule out other pieces of metal acting as foci. Operation—Removal of metal fragment and adequate drainage of cavity. No drainage for the past six weeks.

tracts with multiple openings to plug several or all but one in order to reach all of the extensions. This is most readily accomplished by pressure of a gauze covered finger or fingers. Collodion has not been used since the method described when assistants are available is so simple.

In private practice I twice made use of a purse string suture, drawing the skin itself up around the syringe. This was the only way that I was able to inject one tract in the loose scrotal tissues.

The utilization of gravity has been of value in many cases with films taken at intervals.

Lipiodol has been the injected material used here. To conserve lipiodol we have been able to determine the amount of lipiodol which we will need in the syringe

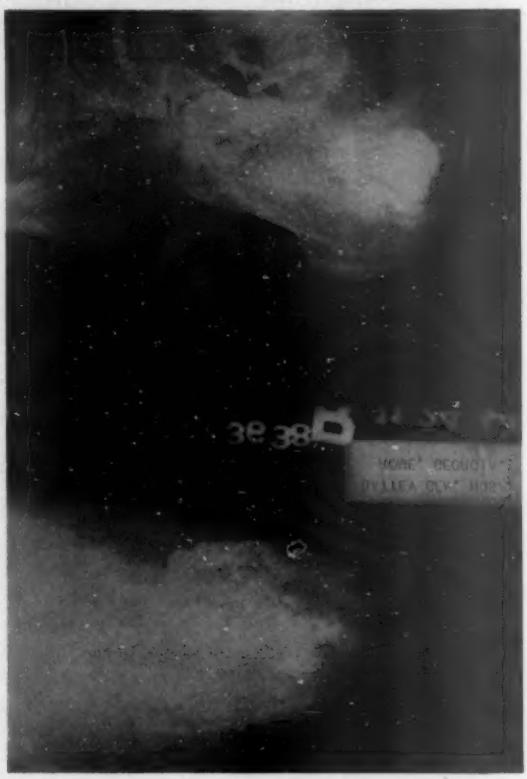


Fig. 7. Case xiii. Cavity in the os calcis. Plain film very indefinite. Marked pressure alternating with suction was necessary to fill the cavity. Operation —Removal of three sequestra and considerable granulation tissue.

Fig. 8. Case xiv. Cavity in badly comminuted fractures of the tarsal bones. The cavity or tract involves the calcaneocuboid and the anterior subastragalar joint. Tract traverses the length of the os calcis and emerges posteriorly. There is a lateral extension. Operation—Cavity unroofed. Sequestra and granulation tissue removed. Patient has had no drainage for two months. Arrow points to the rubber cap protecting the tip of the injecting mechanism. This rubber cap is indispensable in the injection of certain types of tracts.

by the amount of drainage. This has been a correct estimate in a great percentage of cases. It is best to have too much in the syringe as its removal for filling causes spillage from the opening in the skin or mucous surface. At times in large cavities it might be advisable to mix the lipiodol with equal parts of sterile olive oil. Lipiodol appears to have some therapeutic value of its own as many cases have had a cessation of drainage after injection.

The question of how much pressure to use in a given case is most difficult. There have been cases of lipiodol passing into the

Fig. 9, *A* and *B*. Case xvii. A cavity in the lateral condyle of femur and adjacent tibia. If this patient is ever to be treated by arthroplasty, then complete eradication of the cavities is probably indicated. There are many cases with cavities very near or actually bulging beyond the articular surface of bone. Many of these have spontaneously closed. Some have remained closed and others have reopened.

Fig. 10. Case xviii. Cavity in the ilium at edge of acetabulum connecting with the joint cavity. Note lipiodol outlining the joint capsule. No ill effects from this. This is not desirable, but could hardly be avoided in this case. This film made twenty-four hours after injection. Films made one week later showed considerable absorption of lipiodol from the hip joint?

veins draining the uterus in hysterosalpingography, but no serious effects have been noted from this. I had this happen in one hysterosalpingogram and have films showing the lipiodol in the iliac veins. There was mild shock but no ill effects. This probably would not happen in these cases because of the surrounding fibrosis. I do not hesitate to use marked pressure alternating with release of pressure to introduce the first cubic centimeter as there are often little plugs that may act in a ball valve manner or may simply plug the opening. After this point is passed then undue pressure should not be utilized.

Fractional injection in one bone cavity was valuable. This patient had a pin-point opening and a few minims of lipiodol raised the pressure so that more force was inadvisable and also impossible. The injector was removed and pus came out. This was repeated ten or twleve times with the heavier lipiodol displacing and expelling the pus until a large cavity was filled.

In a mass of granulation tissue the point of exit may be determined by pressure. At one point a drop of pus will exude pointing to the likely injection site. At times small sequestra in the tract will interfere with injection and have to be removed.

After injection the problem of retention of the medium during film examination is usually met by having the patient or ward man hold the syringe or by holding the syringe by sandbags. Both have been used and both are satisfactory with the former much simpler. A frequently used method of retention of the lipiodol is by sliding a

Fig. 11. Case xix. Cavity between fragments. No sequestra or foreign bodies. Cavity only three-fourths surrounded by bone as shown by multiple views. It appears that this type of cavity only partially surrounded by bone tends to heal spontaneously when no foreign material is present. These act about the same as soft tissue cavities.

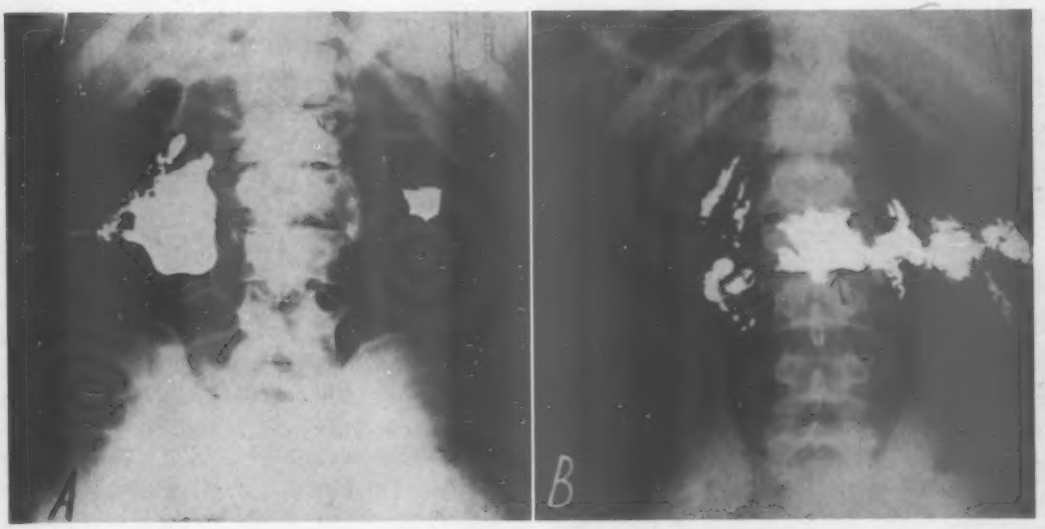


FIG. 12. Case XX. *A*, lipiodol fills a large cavity in the left abdomen. Healing comminuted fracture of the body of the third lumbar vertebra. *B*, illustrates the use of gravity. Patient was turned on right side for several hours. Lipiodol fills a large cavity in the body of the third lumbar (arrow) and passes to the right to fill a cavity containing the large fragment of metal.

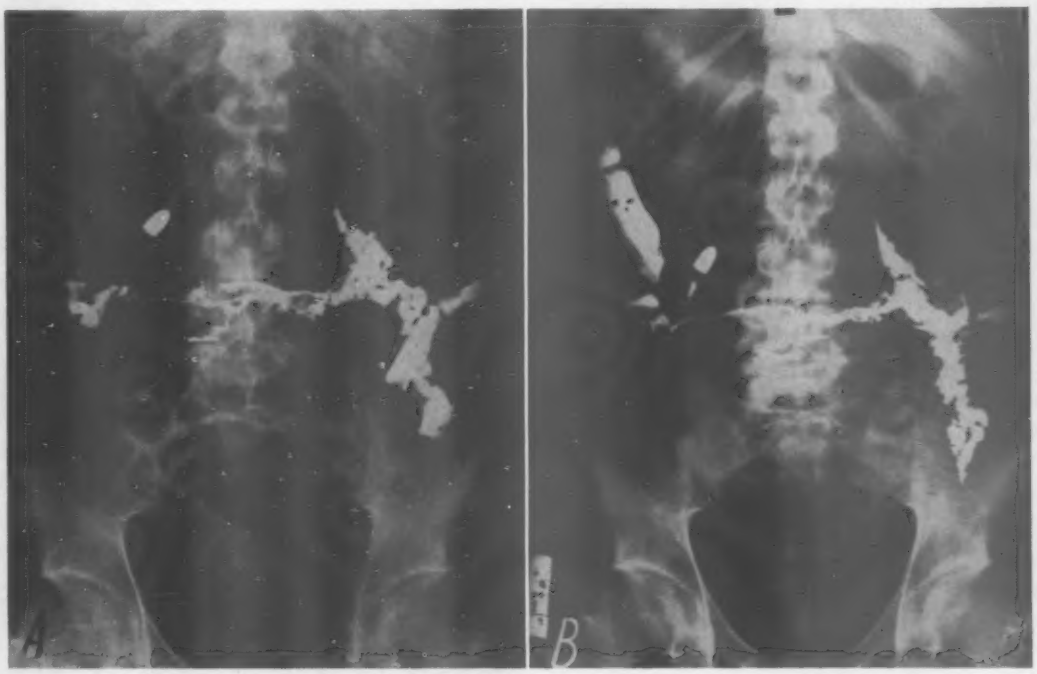


FIG. 13. Case XXIII. *A*, long complicated tract through the body of the fourth lumbar vertebra. Arrow points to a shadow resembling a drainage tube. This shadow represents the site of a tube that had been in place for several weeks. Twenty cubic centimeters of lipiodol was used and the patient turned on his abdomen for twenty-four hours. No bowel connection was demonstrated. The metal foreign body is on the left side. *B*, on second injection 35 cc. of lipiodol was used. The tract connected with the descending colon lateral to the bullet. There was also a connection with the ascending colon near syringe tip. Only a very small amount entered the ascending colon and a large amount the descending colon. The lipiodol also gravitated to the bullet.

Fig. 14. Case xxvi. A tract leading from a posterior opening through a cavity in the right sacroiliac to enter the cecum. There is also a fistula from the anterior abdominal wall to the cecum. Internal fistulas leading from bowel to bone must always be correctly evaluated. It would do very little good to saucerize and curet a cavity that is being fed by colon contents. Odor is no criterion of connection with bowel. Fecal drainage has not been observed. The fistula to the bowel must be repaired first, and then the bone abscess treated. Connection with the bowel can be demonstrated with methylene blue by mouth, but the location cannot. Operation—Fistulas disconnected and bowel repaired. Bone focus to be operated on if drainage continues.

gauze covered finger quickly over the opening as the injecting mechanism is removed. This is especially easy when the pliable rubber mechanism is used. In the illustrations it will be seen how little the fingers and hands interfere with detail. It is easy to slide a piece of clean dry gauze in place of the one plugging the opening without spillage. This prevents confusing shadows from any initial leakage.

It is surprising how little evidence there may be on the plain film of a cavity in bone. Sclerosis around a defect is not an indicator as this may occur around a defect by chemical or thermal irritation from the passage of metal through bone. Also the sclerosis may be so slight that it is not visualized.

Plain roentgenograms should always be made before injection.

Roentgenograms should always be made even when there is apparently no chance of enough lipiodol entering to be of any value. We were agreeably surprised in several cases. Large films should be taken whenever a tract around the trunk is investigated. One word about technique may save re-examinations. It is advisable to routinely add 5 kv. to the regular technique.

Stereoscopic roentgenograms are imperative in complicated tracts. To these should be added a film made at a right angle to the stereoscopic projection. Oblique films are at times necessary. Anteroposterior and lateral views are usually sufficient.

So far as I know there are no contraindications to the injection of lipiodol into a sinus or fistula except an acute or subsiding acute inflammatory process. Complications so far have had no serious after effects and have been limited to 3 cases. Two cases with abscess cavities in the upper end of the tibia near the knee joint had febrile reactions with chills and some swelling of the joint. Both recovered quickly under sulfonamide therapy. The third case

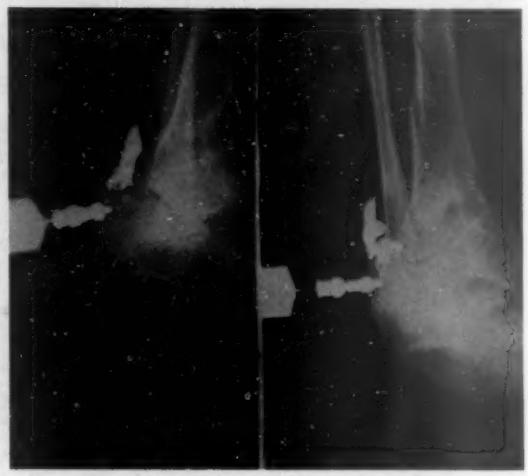


Fig. 15. Case xxvii. Soft tissue abscess ruling out bone focus. Operation—Incision of cavity with removal of a piece of canvas legging. No drainage now.

showed a connection with the hip joint, but no ill effects. The patient has almost complete range of motion of this joint with very little pain. Some local minor flare-ups have occurred consisting of slight soreness for twenty-four hours.

Everyone is familar with the long history of chronic osteomyelitis with its quiet periods and apparent healing followed by flare-ups and further drainage. These post-traumatic cases seem to present a different picture roentgenologically. This series presents less sclerosis and thickening of bone around the cavities. Perhaps this will come in time as these cases are much earlier than those usually seen in private practice. The mechanism of production of the two is different. The former is a pressure and inflammatory necrosis from within, the latter from without, establishing a tract at the onset. Many of these cases close spontaneously. Many reopen and drain while the patient is still in the hospital. The question I would like to raise is whether every draining sinus of more than one month's duration should not be injected fairly early and whether or not on demonstrating a cavity this should be opened, curetted, and adequately drained, providing of course, that there is enough bone support for union. These spontaneously closed cavities may in later years be caused to flare up by trauma or by some debilitating disease. At present the policy is to inject all draining sinuses of a month's duration. It can probably be stated without exception that any cavity containing a foreign body either bone, metal, or other material should have that foreign body removed.

The cases illustrated have been taken from the 150 cases injected from January, 1943, through April, 1945, in the Department of Roentgenology at Battey General Hospital. Many interesting cases have been omitted because of space requirements. Many lateral or anteroposterior views have been omitted for the same reason. Since the completion of this paper we have had one case of a type not shown in the illustrations included here. This sinus passed in from the left flank to connect with a large metal foreign body in the body of the first lumbar vertebra. From the middle of the tract there were two connections with the kidney.

CONCLUSIONS

1. Many uninfected defects in bone as the result of penetrating metal show a surrounding zone of sclerosis. Many other cases have foreign bodies in the soft tissues and bone. The continued drainage may be due to either the foreign body or the cavity in bone. Lipiodol will usually determine which or both.

2. There are many infected cavities in bone which have an internal connection with the bowel. It is probably always correct to repair the fistula first.

3. Cavities near or in joints probably require treatment if these patients are to be treated later by arthroplasty.

4. It seems that the optimum time for operative interference is as soon as the bone is strong enough to prevent fracture. The longer a cavity remains with infection, inadequate drainage, or foreign bodies the more fibrosis and the less likelihood of closure.

5. At times the tract leading to the focus is very long and passes near important structures or organs. In many of these cases it would not be advisable to follow the tract in operating. Lipiodol injection in determining the location of the focus allows a planned and more effective operative approach.

6. This work does not presume to add any new diagnostic features to the interpretation of the roentgenograms. It is hoped that the technical points in injection will be of value to anyone performing these studies.*

333 West Main St., S.
Gainesville, Florida

* Since the preparation of this paper an article on the same subject has appeared in this Journal (Pendergrass, R. C., and Ward, W. C. Roentgenographic demonstration of sinuses and fistulae. Am. J. Roentgenol. & Rad. Therapy, 1947, *57*, 571–577).

PRINCIPLES OF FAST ELECTRON THERAPY IN CANCER*

By ERICH M. UHLMANN, M.D., F.A.C.R., *and* LESTER S. SKAGGS. PH.D.
CHICAGO, ILLINOIS

IN CONSIDERATION of the progress made during the past fifty years in the treatment of malignant diseases by means of radiant energy, it is justifiable to state that the physical and therapeutic possibilities in this field have neither been exhausted nor utilized to their fullest extent. The developments in nuclear physics are of too recent date to have gained great importance in their biological application. The work in this field is only in its incipient experimental stage.

One form of radiant energy has attracted our special interest for many years, namely, the production and use of free electrons in the treatment of cancer. This idea does not seem to be extraordinary or even original, when it is recalled that the biological effects of roentgen rays and radium are due to secondary electrons which are produced when roentgen rays pass through tissue. The advantage of using free electrons directly for therapeutic purposes is found in their physical characteristics. They are small particles of matter, which, after being freed from their source, have a limited pathway. For all practical considerations their range is determined by the power which generates the electrons and this is therefore relatively easy to calculate and to control. Also of importance is the fact that the highest concentration of energy in an electron beam is not at the source, as is the case in the more traditional forms of radiation, but rather at the end of the beam.

These characteristics should have caused electrons to be attractive for the treatment of malignant disease and, indeed, such efforts have been made for many years. The reason for not taking advantage of this form of radiant energy lies in technical difficulties which have made it heretofore impossible to build the powerful generators necessary to create free electrons of sufficient intensity.

The range of free electrons produced with voltages generally used in deep roentgen therapy would be limited to fractions of 1 mm. in depth. Such electron beams are, of course, of little therapeutic value. In order to derive benefits from this source of radiant energy, electron beams have to be produced with a range of at least 15 to 17 cm. in depth, which in turn require electric energy of many million volts.

This problem was approached in a practical way for the first time by Lange and Brasch who built an impulse generator with 1.7 and 2.4 million electron volts. Their work was followed by Trump, Van de Graaff and Cloud who constructed a high voltage generator and an acceleration tube of up to 3 million electron volts. Free electron beams produced with these powerful apparatus provided for a range of several millimeters and fostered the hope that, in pursuing the technical principles of construction, greater ranges might be achieved. The construction of machines of greater and greater voltages on these principles, for the production of free electron beams, however, became obviated by the development of the betatron by Kerst.

The betatron opened an entirely new technical approach to this problem, and promised the production of a free electron beam with sufficient range for actual use in the treatment of deep-seated malignancies.

The present limitations in the use of radiant energy from traditional sources are not due to the fact that roentgen rays or gamma rays of radium do not sufficiently destroy malignant cells, but rather that in doing so they also damage normal tissue.

* From the Tumor Clinic of Michael Reese Hospital. Presented at the Forty-eighth Annual Meeting, American Roentgen Ray Society, Atlantic City, N. J., Sept. 16–19, 1947.

The radiation effects from roentgen rays and gamma rays decrease with the square of the distance from the source, and the amount of radiation which can be safely administerated is generally limited by the tolerance of the skin. In order to apply lethal doses to malignant tumors within the body, different entrance fields are chosen for the rays, and thus crossfire the body tissue. Such radiation produces undesired and unnecessary effects on the tissue surrounding the tumor, and thus limits their use in the actual treatment of malignant disease.

In contrast, a free electron beam of sufficient energy can be directed and applied in such a manner that the concentration of energy is greatest in the tumor itself and not in the skin. Practically no radiation effects will take place beyond the stipulated depths and the energy concentration in the overlying tissue, through which the electrons must pass by necessity, will be smaller than in the tumor.

When the betatron was first developed by Kerst it was used as a machine to produce roentgen rays. Since the acceleration process for producing a free beam of electrons is the same as that for the production of roentgen rays, it was felt that this was an avenue of approach for solving the problem of utilizing electrons for cancer therapy. The work to be reported here was carried out by one of us (L. S. S.), with the close cooperation of Kerst, Almy and Lanzl. We were privileged to use the 20 million electron volt betatron originally built by Kerst and at present in the Department of Physics at the University of Illinois in Urbana. Construction alterations in the original machine were necessary to make it suitable for the liberation of a free electron beam.

The betatron works on the principle that a quantity of electrons from a tungsten filament is injected into a vacuum chamber between the poles of an alternating current electromagnet. A fraction of the injected electrons is captured in circular orbits. Here they receive energy from the increasing magnetic field, gaining about 70 electron volts per turn and making about 300,000 turns to reach full energy in the case of the 20 mev. machine. After reaching their required energy, the diameter of the electron orbit is expanded. If the goal is to produce roentgen rays, the electrons are caused to strike a platinum target. In order, however, to produce a free beam of electrons from the betatron it is necessary to have an unobstructed path. The target, therefore, was removed and the injector so placed that the electrons during expansion of the orbit may move out and reach the region near the edge of the magnetic field, where they start moving in spirals of large pitch. If nothing further were done, the electrons would continue spiraling, and would come out through the walls of the magnetic chamber and spread in all directions about the machine. However, if a magnetic shunt is placed at the beginning of the spiraling region, the magnetic field in this area is nearly zero. This makes it possible for the electrons to enter this region and move in nearly a straight line for a distance of 10 cm. They emerge in a field which is so weak as to receive only a slight magnetic deflection before they pass through the window of the vacuum chamber and escape entirely from the influence of the magnetic field.

Without going into details of the technical construction, it may be said that the described method of removing the electron beam works satisfactorily. After slight adjustments we were able to obtain a well collimated beam of electrons from the betatron. The most intense beam yet observed produced ionization effects in a Victoreen thimble chamber at a distance of 1 meter from the window equivalent to that produced by 100 roentgens per minute of roentgen rays. At 35 cm. from the window an equivalent of 1,500 r per minute with an 8 square cm. field was observed. It is expected that this intensity can be improved by a factor of 10 or 100.

The main part of the beam of electrons as it emerges from the window has a height

of about 2 mm. and width of about 6 mm. A cross sectional appearance of the beam shows a fanlike tail which is produced by electrons which are not completely captured by the magnetic shunt. This tail can be eliminated by permitting the beam to pass through an aluminum window with a thickness of 1/1000 of an inch.

The electron beam from the betatron suffers considerable scattering in the air beyond the window. A cross section at a distance of 10 cm. reveals that the beam no longer has its original sharp outline and that the edges have become diffused. At this distance, the height is about 6 mm. and the width 13 mm. At 35 cm., the beam is about 2 cm. high and 4 cm. wide, and at 1 meter the beam has a mean diameter of about 12 cm.

If, however, the beam after emerging from the doughnut is allowed to enter another evacuated space, the divergence can be limited and the beam will remain small and well defined.

The electron beam produced in the 20 mev. betatron does not produce sufficient ionization in air to be self luminous, but its path can be made visible by placing a fluorescent screen in the beam at a slight angle. The actual penetration of the electron beam was determined by sandwiching a sheet of film between two pieces of presdwood of density equal to that of water. The edge of the film was coincident with that of the presdwood blocks which face the beam and the plane of the film was approximately parallel to the beam. A beam produced with 13 mev. penetrates 6 cm. which is in agreement with the theoretical predictions. Based on our calculations, a 30 mev. beam would produce more than 14 cm. penetration and a 35 mev. beam, 17 cm. The actual depths reached are now being measured and it is expected that they will conform with the theoretical calculations. These figures indicate a constant change in ionization which continually increases from the surface to a point near the end of the range. Beyond this end, there is a sharp decrease to practically zero ionization. The exit dose of an electron beam from the betatron is extremely small, and when measured behind 10 cm. of presdwood was found to be about 1 per cent of that at the front surface.

Collimation of a beam of electrons is relatively simple. Lead, however, is not a satisfactory material for this purpose, because it produces a large yield of roentgen rays when struck by high energy electrons. As the efficiency of roentgen-ray production decreases rapidly with decreasing atomic number, material of low atomic number such as hydrocarbons are very suitable for collimation. Wood or plastics are probably the most economical and satisfactory.

In conclusion, this outline describes the production of an electron beam from the betatron. It was shown that this beam can be well collimated, is homogeneous in energy, and of sufficient intensity to reach deep-seated malignant diseases. Considerable experimental work, however, remains to be done before clinical application of the betatron in the treatment of malignant tumors can be safely recommended.

Michael Reese Hospital
Chicago 16, Ill.

DISCUSSION

DR. J. G. TRUMP, Cambridge, Mass. Dr. Uhlmann and Dr. Skaggs and also their associates at the University of Illinois, particularly Dr. Kerst, are to be commended for their pioneering investigation of the use of high energy electrons for the treatment of deep-seated tumors. The possibilities of cathode rays for therapy have been appreciated for many years, but were limited by the relatively low ranges in tissue which were then available. The betatron and various linear accelerators now under development offer for the first time a means of giving such particles sufficient range to reach deep-seated tumors. The ranges indicated by Dr. Skaggs agree closely with the maximum penetration of 1 cm. per 2 million volts which we observed some years ago with a Van de Graaff electrostatic accelerator.[1]

[1] Trump, J. G., Van de Graaff, R. J., and Cloud, R. W. Cathode rays for radiation therapy. AM. J. ROENTGENOL. & RAD. THERAPY, 1940, *43*, 728–734.

It is well established that the biological effect of high energy electrons and roentgen rays should be closely similar for the same amount of absorbed energy. Both these radiations release within the volume of the absorber the same kind of low energy electron ionization which produces the biological effect. The attractiveness of cathode rays for therapy, as pointed out by Dr. Uhlmann, lies in the fact that for an individual electron the ionization density is a maximum at the end of its path. This would lead one to expect that a concentrated ionization dose could be delivered deep within the body with relatively little dosage sustained by the intervening tissue and no radiation dosage sustained beyond the maximum range of the particles.

This favorable characteristic of individual electrons, however, is considerably modified by scattering. When a parallel beam of electrons enters tissue, the electrons do not all proceed in an undeviated course, but are scattered sidewise with the result that the maximum ionization produced by the beam occurs in the first half of their range.

Fortunately, because of momentum considerations, it would be expected that electrons of 20 to 40 million volts would scatter less than electrons of a few million volts. This would have the effect of moving the region of maximum ionization somewhat closer to the maximum range for such electrons. Nevertheless, in bringing the region of maximum ionization to a tumor at 10 cm. depth, for example, cathode rays of over 40 million volts would probably be required. Such radiation would produce considerable ionization beyond the tumor and possibly at the exit skin. It will be interesting to have this distribution of ionization further investigated by the authors as they proceed with their work.

In this connection it is of interest to observe that corresponding and perhaps even more efficient localization of deep tumor doses can be accomplished by roentgen rays of suitable energy.[2] This slide shows the conventional three-portal cross-firing technique used on a cylindrical phantom using a 2 million volt roentgen-ray beam at a 1 meter distance. In this case the tumor dose is 60 per cent higher than the maximum dose sustained anywhere outside the tumor. The threshold erythema dose for such 2 million volt roentgen radiation is in excess of 4,000 roentgens when administered in daily doses of 300 r. The next slide shows the distribution of ionization in the same phantom produced by continuous crossfiring technique. The tumor dose is now several times higher than that sustained by nearby tissue and over five times greater than the skin dose.

In conclusion, it is evident that both high energy cathode rays in the 20 to 40 million volt range and supervoltage roentgen rays in the 2 and 3 million volt range are capable in principle of delivering high deep tumor doses with a minimum damage to surrounding healthy tissue. If the cathode-ray beam can be kept relatively free from accompanying low energy electrons, it is probable that unusually high skin tolerance will be observed at the portal of entry, similar to that found with supervoltage roentgen rays. The use of the high energy cathode rays for deep tumor irradiation is a new possibility in therapy, and its investigation deserves particular attention and support.

[2] Trump, J. G., Moster, C. R., and Cloud, R. W. Efficient deep tumor irradiation with roentgen rays of several million volts. Am. J. Roentgenol. & Rad. Therapy, 1947, *57*, 703–710.

PART TIME RADIOLOGICAL PRACTICE IN HOSPITALS OF SMALL CITIES

By WILLIS S. PECK, M.D.
TOLEDO, OHIO

MANY communities of 10,000 to 25,000 population do not have a qualified full time radiologist.[1,2] It is doubtful if most of these communities now offer enough opportunity for advancement to attract one. In time, with a continued increase in the demand for radiology and completion of the proposed hospital building program, some of these smaller centers of population will support a radiologist. Most physicians who find it necessary to interpret roentgenograms for themselves are not well satisfied with the results of this practice. Hospitals which do not have specialists in radiology on their staffs are anxious to improve their roentgen-ray services. There is no lack of willingness on the part of most small hospitals to conform to the desirable standards[3,4] which have been recommended. Unfortunately, these standards, as far as obtaining qualified radiological consultation is concerned, are not easily met. In order to supply this consultation service,[5] physicians and hospitals in some of these communities are seeking part time visits from experienced radiologists located in neighboring large cities.

This discussion is presented to describe how one group of radiologists attempted to meet the demands for roentgen-ray service in outlying hospitals situated near a large city. This group is located in a city of 300,000 population situated in one of the more populous mid-western states. They maintain private offices and they also direct hospital roentgen-ray departments in their home city. In the beginning, the group was formed by a local radiologist inviting an out-of-town radiologist to join him in practice. Later, a third and then a fourth radiologist joined the group as the demands of the practice increased. Even before the war time shortage of radiologists became acute, this group had consented to make regular biweekly visits to conduct the roentgen-ray activities in three neighboring communities. This was arranged in addition to their office and hospital practice within the city limits. After Pearl Harbor, a hospital in another city was added for the duration of the war.

The first out-of-town venture by these radiologists was begun eight years ago at Hospital "A," an institution of 75 beds, serving a community of 25,000 population forty miles away from the city. No radiologist was available locally and the medical staff with the hospital authorities requested help in conducting the department of radiology. Within one year, a new hospital of 50 beds, Hospital "B," was opened in a community of 10,000 population fifteen miles from Hospital "A" and only forty-five miles from the city. A request was made by this hospital for visiting radiological service under the same plan. Because of their proximity it was possible to combine visits to Hospitals "A" and "B" on the same trip, thereby reducing the total travel time for each.

Six years ago Hospital "C," of 75 bed capacity located in a city of 15,000 population, asked for help with its radiological problems. This city is located thirty-five miles northwest of the home city, whereas Hospitals "A" and "B" lie to the east. When the radiologist who had practiced in this community died, the hospital purchased the apparatus which he had installed in it. Since there was no other radiologist in this community, the physicians and the hospital authorities requested the services of the group from the larger city. Adequate professional service to this hospital necessitated two visits each week totaling one to one and one-half days. To provide for this additional work load, it was necessary for the group to expand by the addition of a third radiologist.

Hospital "D," of 100 beds, located in a

25,000 population city was fourth applicant for consultation service. To meet its request, the radiological associates were required to extend by sixteen miles the eastern leg of their circuit. The distance to the east was now too great to be practicable except as a war time accommodation. It was undertaken only with the understanding that visits would be discontinued when the radiologist situated in the outlying city returned from military service. During the three and one-half years that this hospital was included, films were mailed once each week to the city office of the group. In addition, once each week, this hospital was visited by a group member as a part of the eastern trip which now required a minimum of twelve to fourteen hours, even under the most favorable travel conditions. Since the end of the war, our radiological service has been discontinued in Hospital "D" but continued in the original three hospitals.

In many localities, visits to three hospitals in one day, and a trip of one hundred thirty miles would not be possible. In this instance, the location of the hospitals in proximity, excellent roads which are seldom impassable in winter, and a level terrain, require that only a relatively small portion of the day be spent in transit.

These small city hospitals were founded by contributions from the local community and by large individual bequests. Their continued support comes from local citizens, community groups, church organizations, the hospital guild and occasionally from the municipal government. The board of directors of these hospitals usually include individuals or their representative who have contributed generously to the hospital, business men of the community and one or more physicians. The desire of all is to make the hospital in which they are interested as self sufficient and up to date as possible. In order to do so, the roentgen department as well as other divisions of the hospital must meet certain requirements. Hospital boards are usually well informed regarding the importance of professionally supervised roentgen-ray activities. By first-hand individual experience and through the advice of medical associates, board members are impressed with the fact that radiological services of high quality constitute an essential phase of hospital procedure. It is because administrative bodies look upon radiology as a primary hospital function that sharp differences in opinion have arisen with radiologists who seek to preserve strict private practice status in all their activities.

An experienced radiologist engaged in active private practice knows well the pitfalls which attend improper organization in the roentgen department of a hospital. Frequently, he can prevent dissatisfaction on the part of the board by explaining the function of the radiologist and by emphasizing his standing as a medical consultant.

The periodic visits of a consulting radiologist to outlying hospitals are necessarily limited in time. Organization of his time and efficient planning of all departmental activities is the secret of a pleasant and successful visit. Much of the technical work, outlined and directed in advance, should be completed before he arrives. Finished roentgenograms should be assembled and immediately available for his inspection. Pertinent information relative to the diagnostic examination should be collected by the technician in readiness for the radiologist. If the patients to be examined by him personally have been given a specific appointment for the occasion of his visit they can be handled without great time loss. The balance of the radiologist's visit is devoted to the very important function of professional consultation with his medical colleagues. The value of this last activity will depend upon the performance and ability of the radiologist as well as his personality.

In most instances, hospitals have been established long enough to acquire some roentgenologic equipment and develop floor space for the roentgen department before the trained radiologist is engaged. He must, therefore, put up with the physical plant which is available until he can plan and secure arrangements more to his

liking. There are certain physical requirements essential to the successful operation of any hospital roentgen department. These are determined by the number and type of patients in the hospital, the average length of hospital stay and the number and type of out-patients examined. If roentgen therapy is employed, adequate space for equipment, dressing rooms, examination facilities, and a waiting room for patients must be provided. Only those types of equipment which will be used frequently are justified. If an estimate of the number of fracture, gastrointestinal, urological and chest cases during one year is secured, a basis for equipment needs can be established. Special apparatus, as for example, that employed in examination of the skull is very useful but not essential in a small hospital.

A general hospital of 50 to 75 beds serving a community of 10,000 to 20,000 population needs as a minimum the following roentgenologic equipment: one combination fluoroscopic and roentgenographic tilting roentgen table, one fluoroscopic tube below and another roentgen tube above the table with energizing apparatus of 200 milliampere capacity. The added expense of a rotating anode tube seems justified if new equipment is to be purchased. One cassette changer and one mobile roentgen machine with about 30 milliampere and 85 kilovolt capacity are also needed. Usually the electrical circuits in the patients' rooms are inadequate for maximum operation, but special wiring should be available in the fracture room and the mobile apparatus used there whenever possible. Accurate and dependable temperature control for film processing solutions is a frank necessity; it is not a luxury. It is poor economy to permit laxity or inaccuracy in the processing of roentgen film which is a costly commodity, and upon whose roentgenographic quality, good clinical results depend. A generous stock of roentgen films in a light-proof film bin, adequate cassettes for any type of examination, a supply of film hangers for a half day's work, and a film dryer of two dozen film capacity are required. In the consultation room a bank of four viewing boxes and a stereoscope are required for proper demonstration and interpretation of films. Files for active films, the storage of inactive films, identification cards and diagnostic indexing of cases must be readily accessible. The personnel employed in the roentgen department should include a well trained and experienced technician, a relief technician who may spend part of her time in another part of the hospital and a part time stenographer who can take and transcribe medical dictation.

Planning in advance with the technician how the work is to be carried out in his absence will save much time for the radiologist during his subsequent visits. A list of all types of roentgen examinations ordinarily performed in the department, designating the various views to be made for each examination and the size and number of roentgen films required in each instance is advisable. This list, prepared by the radiologist, avoids leaving the choice of views to the technician or the referring physician and helps to prevent re-examination during the radiologist's visit because he finds filming inadequate or improperly performed. Patients referred for routine roentgen examination should not be scheduled during the radiologist's visit. Those for examination of the gastrointestinal tract may be scheduled according to either of two different routines. If the radiologist visits the hospital in the morning, the patient should receive his barium at the time he is fluoroscoped by the radiologist. If the visit does not occur before noon, the patient should be scheduled to appear four to five hours beforehand, given the barium meal and films made of the stomach and duodenum. This method of procedure gives the radiologist a preview of the stomach and duodenum, permits observation of the rate of movement in the upper gastrointestinal tract at the time of his fluoroscopy, de-

creases the amount of subsequent filming and avoids further delay before the patient can be fed.

Direct roentgenological consultation in emergency situations is not available in a hospital served by a visiting radiologist unless such situations arise during or shortly before the specified time of his visit. Actually, this shortcoming is less important than many persons are apt to believe, because few roentgen examinations fall in the true emergency category. A firm stand by the radiologist in the matter of postponing the roentgen examination of patients with severe injuries, such as skull fractures, until the more important treatment for shock has been instituted, is sound medically and results in less hurried and therefore more accurate and informative roentgenograms. Most physicians in outlying hospitals have been in the habit of treating fractures without the help of a radiologist or of a traumatic surgeon. In the case of difficult fractures it is frequently necessary to call a specialist from a larger center or to send the patient to him for treatment. In the meantime, films can be sent to the radiologist or he will see them during the next scheduled visit. Probably the greatest value of the radiologist to the general practitioner in the management of fractures comes from discussions regarding further procedures, when the immediate attempts at reduction have not been entirely satisfactory. A radiologist who is consulting daily with orthopedists and traumatic surgeons of a large community acquires a fund of knowledge about fracture work which will make his judgment and advice of considerable value. Frequently the practitioner with a severe fracture case is undecided whether or not he should seek expert consultation. The radiologist may tactfully suggest, through an explanation of the points involved as shown by the roentgenographic examination, what may be the most advantageous procedure for the patient and physician. In a consulting practice of this type it is seldom necessary for the radiologist to provide fluoroscopic assistance during the reduction of fractures. Staff physicians should use the fluoroscope for such purposes only under the control of the technician, to insure due regard for the safety of examiner and patient. The upper limit of fluoroscopic exposure must be stated specifically by the radiologist, and the technician must have authority to discontinue the roentgen ray if this amount is exceeded.

During the interpretation of roentgenograms much interesting material passes before the radiologist. It is our practice to classify all cases at this time according to diagnosis. For this procedure the simple and very workable system devised by Hodges and Lampe[6] is used in these hospitals. Standardization in all activities of the group in the matter of record keeping has served to coordinate the clinical experiences at all hospitals as well as the private office practice.

Administration of roentgen therapy on a consulting visit basis presents a very difficult problem. Certainly from the viewpoint of the group radiologist the simplest and most satisfactory course to follow is to require that all ambulatory patients travel to his established office and have bed-ridden patients transferred to hospitals served by the group in the home city. From the viewpoint of the patient and in the eyes of the management and medical staff of the small city hospital this is scarcely to be considered ideal.

Difficulties in securing daily transportation of patients to the city for a number of successive weeks is an insurmountable obstacle in some cases. Many patients from outlying districts will not forego the association with their family and friends resulting from confinement in a hospital away from home. They will, however, go to the local hospital in which they have confidence and where they believe they will be more comfortable. Local pride of hospital authorities, citizens and the medical staff in their institution urges that the patients

from their community be kept at home. Without knowing or weighing the factors involved many persons influential in the hospital feel their institution should be able to give roentgen therapy as satisfactorily as those in large cities.

Before the group became interested in the out-of-town hospitals, two of these institutions had acquired roentgen therapy apparatus. When the radiologists of the group were asked to direct the departments in the hospitals the question of roentgen therapy presented a real challenge. As a result the radiologists decided to determine if a workable procedure for roentgen therapy could be devised, primarily for patients who could not be treated in the city, in place of giving a dogmatic "no" to consideration of any therapy.

In this plan the technician must be especially well trained in roentgen therapy. Adequate equipment of not less than 200 kilovolt capacity must be provided, as well as proper facilities for examination of the patients. Each patient receives a preliminary examination by the radiologist after referral from his physician. If it appears that he should not be treated in the local hospital and can be transferred to the city for more adequate therapy, the radiologist makes this recommendation to the referring physician. The radiologist must always reserve the right to determine where the patient should be treated. If the patient is to be treated in the local hospital, the history and the radiologist's physical findings are recorded on the treatment record. Specific written instructions regarding dosage and positioning are also recorded. The patient is then given his first treatment by the radiologist with the assistance of the technician. All the subsequent treatments given on the days that the radiologist is present are performed under his immediate supervision. He must also review the treatment record on each of these visits and write instructions for any interim treatment before the next biweekly visit. A responsible physician who has had some postgraduate training in radiology should be employed to supervise and check the technician's treatment in the absence of the radiologist. Because of the radiologist's responsibility, it is advisable for him to inform the patient, before treatment is started, that he will not be present during each treatment. He should tell the patient what arrangements have been made for supervision. If the patient does not wish to take treatment under these conditions he may refuse and the radiologist must return him to his referring physician with the explanation for his action. The biweekly examination of the patient will keep the radiologist informed regarding the development of untoward symptoms and the progress of the lesion. The experienced radiologist who carefully observes his cases should know beforehand when to terminate treatment and avoid either under or excessive dosage.

Roentgen therapy of superficial lesions may be performed if suitable apparatus is available. Treatment of this type is confined strictly to the time of the radiologist's visit and administered under his personal supervision.

The record system should be similar to the one used in the city. Patients for follow-up examination are scheduled weeks or months ahead on the day and hour of the radiologist's visit, and as careful a reexamination conducted as is employed elsewhere. It is the practice to see all such patients from the community during his visits in the local hospital whether they were treated locally or in the city. This encourages more patients to return for post-treatment examinations.

If radiation therapy is administered with a full realization of these limitations and an energetic interest on the part of the radiologist is maintained, the procedure as outlined seems justified.

Intracavitary radium application can be performed by the radiologist on his visit to the hospital, if it is his practice to do this type of work. Patients so treated usu-

ally receive roentgen therapy in his home office or the hospital, thereby allowing him to plan the proper sequence of treatment. The nursing personnel of the hospitals quickly become accustomed to the routine care of patients treated with radium. Specific and clearly stated directions covering all phases of the patient's care, and instructions concerning telephone communication with the radiologist are the same as used in the city hospitals. These have been found entirely satisfactory for the protecting of the patient as well as for the hospital personnel. If no one in the radiological group is equipped to apply radium, it is apt to be administered by those untrained in such procedures, obviously making the results of radiation therapy less satisfactory. All patients who receive radium application are considered the radiologist's private patients.

A recent survey of the departmental records shows that the number of diagnostic roentgenologic cases per year increased 100 to 150 per cent between 1940 and 1946 in all of the out-of-town hospitals. The major increase in Hospital "A" occurred in 1946 after many physicians returned from service. Hospitals "B" and "C" showed their major increases during the war, when large industrial plants were built in the communities. The increases in these hospitals have been maintained since the war and augmented by patients referred from many returned physicians. A continuation of the present level of activities in each radiological department depends upon the financial status of the local community, new hospital construction, and the use of roentgen equipment in the offices of staff physicians. The quality of the service rendered by the visiting radiologist will do much to offset the latter and also maintain present activities.

The most important consideration in discussing remuneration is the assurance that the radiologist will find he is sufficiently well paid to maintain the active interest, which is essential to successful medical performance. If the radiologist does not enjoy his out-of-town visits, no reasonable remuneration can compensate him. On the other hand, if a break in the routine of city practice can be accomplished, without disrupting the continuity of service, as is possible where a group of radiologists is practicing together, these trips may be a welcome diversion. Scheduling hospital visits during time ordinarily devoted to recreational activities, as week-ends or "half days," is not recommended. Such a practice may exact a price out of all proportion to any remuneration received.

Hospitals of less than 50 bed capacity may not have enough roentgen-ray work to pay a radiologist on a percentage basis. In this event, he may receive a fixed sum for each visit. The minimum number of visits per week or per month should be stipulated. With a larger volume of roentgen-ray work, a percentage of the gross income should be received. Remuneration in proportion to the work performed is a definite incentive to his development of the roentgen department. In calculating the radiologist's income, his extra expenditure of time and effort in travel is balanced, at least in part, by the fact that he is not in the hospital for more than a short period during each week.

Charges for roentgen examinations must be determined by the radiologist, and with the agreement of the hospital authorities. They should be in accord with charges for similar service in the locality. Fees for roentgen therapy are determined entirely by the radiologist, after his examination of the patient and outline of necessary treatment. In these out-of-town hospitals, the character of the visits makes it necessary for the hospital to collect the roentgen-ray accounts. Settlement of the radiologist's account at the end of each month is recommended. In order to do this, the amount represented by the current bad debt loss ratio of the hospital may be deducted, in determining the gross income. This avoids endless bookkeeping and permits the radi-

ologist's account to be kept in balance. When the bad debt loss ratio is not determined, the radiologist should receive a percentage of the monthly gross charges. This should be slightly less than the percentage received in the plan previously mentioned. Kirklin,[7] Ullmann,[8] Sante,[9] and Warfield[10] have stated their ideas concerning methods of remuneration. Considering all factors, it appears that the figure of 40 to 60 per cent of gross receipts, or its equivalent, as recommended by Kirklin,[7] is fair if the hospital has a reasonable volume of work and the radiologist's loss because of absence from his city practice is not large.

SUMMARY

(1) The experiences of a group of radiologists in conducting a consultation practice in small out-of-town hospitals is described.

(2) Suggestions for operating a diagnostic roentgenological service are given and necessary equipment listed.

(3) Administration of radiation therapy is not advised in these hospitals except as specified.

(4) The development of departmental activities under the guidance of a qualified radiologist is reported.

(5) Factors determining the radiologist's remuneration are discussed.

2001 Collingwood Blvd.
Toledo 2, Ohio

REFERENCES

1. Directory of Diplomates, American Board of Radiology.
2. Directory of Medical Specialists. A. N. Marquis Co., Chicago, 1946.
3. A Manual of Desirable Standards for Hospital Radiological Departments. American College of Radiology, Chicago.
4. Manual of Hospital Standardization. American College of Surgeons, Chicago, 1946.
5. AMES, F. B. Accomplishments in x-ray. *Mod. Hosp.*, 1944, *63*, 53–54.
6. HODGES, F. J., and LAMPE, I. Filing and cross-indexing roentgen-ray records. AM. J. ROENTGENOL. & RAD. THERAPY, 1939, *41*, 1007–1018.
7. KIRKLIN, B. R. Principles of relationship between hospitals and radiologists. *Hosp. Management*, 1940, *49*, 54–58.
8. ULLMANN, H. J. Requirements of a department of radiology in a small hospital. *Am. J. Surg.*, 1930, *8*, 1053–1055.
9. SANTE, L. R. Relation of a hospital department of radiology to the private radiologist. *Am. J. Surg.*, 1930, *8*, 1056–1059.
10. WARFIELD, C. H. Relation of the radiologist to the hospital from the standpoint of the radiologist. *Hospitals*, 1942, *16*, 108; also, *J. Kansas M. Soc.*, 1942, *43*, 450–453.

Vol. 61, No. 2

DEPARTMENT OF TECHNIQUE

Department Editor: Robert B. Taft, M.D., B.S., M.A., 103 Rutledge Ave. Charleston, S. C.

CONTRIBUTION TO THE TECHNIQUE OF BRONCHOGRAPHY IN ADULTS*

By L. WALK

THE introduction of a rubber tube into the trachea, for bronchography, is apparently considered to be technically difficult, and this even seems to inhibit a wider use of bronchography. In this article a simple method is described.

The patient is sitting, leaning about 10 degrees forward. A duodenal tube is held between the second and third fingers of the left hand (Fig. 1); these two fingers with the tube are introduced into the pharynx, behind the epiglottis which can be easily palpated, and the epiglottis together with the tongue is pulled forward somewhat. The tube is thus held against the posterior surface of the epiglottis. The patient is asked to breathe deeply. *During every deep inspiration* the free right hand pushes the tube 1 or 2 cm. forward; the fingers of the left hand holding the tube are somewhat loosened for this. When the tube has entered the trachea, it is felt falling loosely (contrary to the tight going if erroneously introduced into the esophagus). If the first attempt is not successful, the next is made with the patient leaning a little more forward (up to 45 degrees). The introduction is performed without light, the roentgenologist thus adapting his eyes for the following roentgenoscopy. The iodized oil is instilled under roentgenoscopic control; diagnostically valuable aspects and moments are fixed by means of fluoroscopic spot films.

Before the introduction of the tube the patient has to fast and is prepared as follows: Half an hour before the exploration morphine (or best dihydrocodeinone) plus atropine is injected. Then the throat is anesthetized by means of soft cotton brushes; first the pharyngeal arches, the upper and then the lower part of the piriform recesses are anesthetized (e.g. pantocaine 2 per cent, to which 1 to 2 drops of adrenaline per cc. have been added), the anesthetic spreading over the pharyngeal mucosa even where not touched by the brush. Usually three to four brushes are sufficient. An introduction of a brush into the trachea is not necessary and only means discomfort to the patient. An inspection of the larynx by means of a mirror follows, looking for vocal cord paresis. Then 2 cc. of the anesthetic is injected into the trachea by means of a laryngeal syringe, which is held at the posterior surface of the epiglottis and is not introduced into the trachea; the injection (under mirror

Fig. 1. Duodenal tube held by the second and third fingers of the left hand, for introduction. A tube with a small metal olive is used.

* From the I. Medical Clinic of the University of Tartu.

control) is done promptly during the inspiratory phase of deep breathing and causes expectoration. A spray may be used for anesthesia instead of the first brushes.

The duodenal tube can be introduced without dyspnea and insults of expectoration even in unilateral vocal cord paralysis.

SUMMARY

A description has been given of a simple method for introducing a duodenal tube into the trachea for bronchography.

Centrallasarettet
Eskilstuna, Sweden

Vol. 61, No. 2

MALLEABLE CONES FOR ROENTGEN THERAPY*

By ROBERT S. LEIGHTON M.D.†
MINNEAPOLIS, MINNESOTA

THE use of small cones for direct treatment of limited areas has become universally adopted in recent years, particularly for lesions in various accessible body cavities. Because large doses may be applied directly to the tumor and because accurate control of the treated areas is possible with intracavitary cones, results in many cases have been very gratifying.

One difficulty that plagues the radiotherapist in the application of this type of treatment is his all too frequent inability to adapt a rigid cylinder to lesions whose dimensions do not approximate a circle. The smallest cylinder that will cover the lesion frequently does not leave sufficient margin of apparently uninvolved tissue to take care of invisible extensions, while a cylinder large enough for the greatest diameter of the lesion will necessitate treating an unjustifiably large amount of normal tissue. Various limiting diaphragms on the ends of the cones have been tried, but are difficult to adjust properly. Another objection to the use of large cylinders in this work is that frequently sufficient space is not available.

An attempt to overcome at least part of these difficulties has been made by the use of "malleable" or "moldable" cones. These were made in the following sizes, 2.5×40 cm., 3.5×40 cm., and 5×50 cm. They are constructed of 1/16 inch lead sheet rolled into cylinders and fitted with hubs to fit the cone carrier of the machine. With simple tools or strong hands the apertures may be changed so that they are adapted to the treatment of a large variety of lesions. The original models were made with soldered seams. This gives some difficulty in molding which would be obviated if seamless lead tubing were used.

In practice, the ends of the cones are coated with paraffin or encased in a thin rubber sheath, since the bare lead is rather unpleasant to use.

To date these accessories have been successfully used in the treatment of carcinoma of the tongue, tonsil, buccal mucosa, alveolar process and palate. The 5 cm. size has also been used for external irradiation in the submental and submaxillary areas to which it may be shaped so that large doses may be given with good protection for the mandible.

FIG. 1.

FIG. 2.

* From the Department of Radiology and Physical Medicine, University of Minnesota, Minneapolis, Minnesota.
† Trainee of the National Cancer Institute.

Figure 1 shows the original group of cones made at the University of Minnesota. Figure 2 is a reproduction of a film exposed with the cones molded in various shapes. The original film showed an even grayness over the treatment area indicating a satisfactory uniformity of field.

University Hospital
Minneapolis 14, Minn.

Vol. 61, No. 2

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

Editor: Merrill C. Sosman, M.D.

Associate Editor: Lawrence Reynolds, M.D. *Assistant Editor:* Ruth Bigelow, B.S.

Editorial Board: A. C. Christie, M.D. E. H. Skinner, M.D. Lauriston S. Taylor

Advisory Board for Pathology: Eugene L. Opie, M.D.

Collaborating Editors: The Officers and Committee Members of the Societies of which this Journal is the official organ, whose names appear on this page, are considered collaborating editors of this Journal. *Foreign Collaborators:* Gösta Forssell, M.D., Stockholm, R. Ledoux-Lebard, M.D., Paris.

Publisher: Charles C Thomas, 301–327 East Lawrence Avenue, Springfield, Illinois.

Issued Monthly. Subscription $10.00 per year, $11.00 in Canada and $12.00 in foreign countries. Advertising rates submitted on application: Editorial office, 110 Professional Building, Detroit, Mich., Office of publication 301–327 East Lawrence Avenue, Springfield, Ill. Information of interest to all readers will be found on page iv.

Officers and Standing Committees

AMERICAN ROENTGEN RAY SOCIETY

President: Lawrence Reynolds, Detroit, Mich.; *President-Elect:* U. V. Portmann, Cleveland, Ohio; *1st Vice-President:* C. M. Richards, San Jose, Calif.; *2nd Vice-President:* E. E. Barth, Chicago, Ill.; *Secretary:* H. Dabney Kerr, University Hospital, Iowa City, Iowa; *Treasurer:* Wendell G. Scott, 510 South Kingshighway Blvd., St. Louis 10, Mo.

Executive Council: Lawrence Reynolds, U. V. Portmann, C. M. Richards, E. E. Barth, H. D. Kerr, W. G. Scott, M. C. Sosman, H. G. Reineke, J. T. Case, C. A. Good, R. C. Beeler, J. B. Edwards, P. A. Bishop, M. J. Geyman, H. F. Hare, Chairman, 605 Commonwealth Ave., Boston 15, Mass.

Program Committee: H. D. Kerr, Iowa City, Iowa, M. C. Sosman, Boston, Mass., J. T. Case, Chicago, Ill., C. A. Good, Rochester, Minn., H. F. Hare, Boston, Mass., U. V. Portmann, Chairman, Cleveland Clinic, Cleveland 6, Ohio.

Publication Committee: P. C. Swenson, Philadelphia, Pa., R. J. Reeves, Durham, N. C., J. T. Case, Chairman, Chicago, Ill.

Finance Committee: E. L. Jenkinson, Chicago, Ill., B. R. Young, Philadelphia, Pa., H. G. Reineke, Chairman, Cincinnati, Ohio,

Committee on Scientific Exhibits: R. A. Arens, Chicago, Ill., E. B. D. Neuhauser, Boston, Mass., C. A. Good, Chairman, Rochester, Minn.

Representative on National Research Council: Robert P. Ball, New York, N. Y.

Editor: Merrill C. Sosman, Peter Bent Brigham Hospital, Boston, Mass.

Associate Editor: Lawrence Reynolds, 110 Professional Building, Detroit 1, Mich.

Assistant Editor: Ruth Bigelow, 110 Professional Building, Detroit 1, Mich.

Editorial Board: A. C. Christie, E. H. Skinner, Lauriston S. Taylor.

Advisory Board for Pathology: Eugene L. Opie.

Fiftieth Annual Meeting: Netherland Plaza Hotel, Cincinnati, Ohio, October 4–7, 1949.

AMERICAN RADIUM SOCIETY

President: Maurice Lenz, New York, N. Y.; *President-Elect:* William S. MacComb, New York, N. Y.; *1st Vice-President:* Leland R. Cowan, Salt Lake City, Utah; *2nd Vice-President:* James A. Corscaden, New York, N. Y.; *Secretary:* Hugh F. Hare, 605 Commonwealth Ave., Boston, Mass.; *Treasurer:* Howard B. Hunt, University Hospital, Omaha, Nebr.

Executive Committee: William E. Costolow, Chairman, Los Angeles, Calif., Charles L. Martin, Dallas, Texas, A. N. Arneson, St. Louis, Mo.

Program Committee: William S. MacComb, Chairman, New York, N. Y., James F. Nolan, Los Angeles, Calif., John E. Wirth, Baltimore, Md., John V. Blady, Philadelphia, Pa.

Publication Committee: Edward H. Skinner, Chairman, Kansas City Mo., Simeon T. Cantril, Seattle, Wash., Harry Hauser, Cleveland, Ohio.

Research and Standardization Committee: Robert B. Taft, Chairman, Charleston, S. C., Jacob R. Freid, New York, N. Y., K. W. Stenstrom, Minneapolis, Minn.

Education and Publication Committee: James A. Corscaden, Chairman, New York, George C. Andrews, New York, A. N. Arneson, St. Louis, Mo.

Janeway Lecture Committee: Douglas Quick, Chairman, New York, N. Y., G. Failla, New York, N. Y., F. W. O'Brien, Boston, Mass.

Representatives on American Board of Radiology: Douglas Quick, New York, N. Y., B. P. Widmann, Philadelphia, Pa., F. W. O'Brien, Boston, Mass.

Committee on Arrangements: E. P. Pendergrass, Chairman, Philadelphia, Pa., John F. Hynes, Wilmington, Del., P. C. Swenson, Philadelphia, Pa.

Advisory Committee on X-ray and Radium Protection of the National Committee on Radiation Protection: Edith H. Quimby, New York, N. Y., J. E. Wirth, Baltimore, Md.

Exhibit Committee: Robert E. Fricke, Chairman, Rochester, Minn., William Harris, New York, N. Y., Milton Friedman, New York, N. Y.

Thirty-first Annual Meeting: Ambassador Hotel, Atlantic City, N. J., June 5–7, 1949.

EDITORIALS

LEGG-PERTHES' DISEASE

THE literature of Legg-Perthes' disease is voluminous. Since first recognized by Legg and Waldenström, later followed by Calvé and Perthes, the literature is replete with articles in which the disease is discussed from all standpoints. The observations of the earlier writers have been proved to be well founded except for the etiology which remains obscure. From the study of pathological specimens, it is now generally accepted that the primary process is an aseptic necrosis, followed by resorption of necrotic cancellous tissue and, last, formation of new bone and cartilage. Among the names given to the condition, none is entirely satisfactory. Perthes' suggestion of osteochondritis deformans is not apt as it suggests an inflammatory process, which it is not. It is neither an osteitis nor a chondritis. Coxa plana is used by some authors to designate a late untreated aspect of the disease, although Waldenström emphasizes the fact that flattening may occur early in its course. Osteochondrosis is becoming a more acceptable term.

The similarity of Legg-Perthes' disease to foci of aseptic necrotic changes in other epiphyses has been noted and it is now generally accepted that the condition in the hip joint is analogous, in fact similar to those found in other epiphyses. Circulatory disturbance is regarded as the exciting cause of the necrosis. Coincidentally reports have appeared of other conditions which can simulate the appearance of Legg-Perthes' disease, such as hypothyroidism, Gaucher's disease, the end results of reduced congenital dislocation of the hip, and possibly, the changes seen in caisson disease which may resemble a late untreated end result of osteochondrosis of the hip.

That Gaucher's disease can produce a similar picture has been described previous to the present time[1] (Reiss and Kato,[2] 1932, Schein and Arkin,[3,4] 1942, 1948). In these papers, the literature of skeletal changes of Gaucher's disease has been reviewed and other earlier instances are given. Arkin and Schein suggest that the Gaucher cells, which are known to surround and infiltrate small arteries and capillaries, at times do so in a fashion sufficient to cut off circulation and to produce aseptic necrosis of bone. In 1938, Albright[5] reported a case of myxedema with changes in the hip joint simulating those found in Legg-Perthes' disease. He quoted Looser who found that the pathological change in hypothyroidism was retardation in the transformation of cartilage to bone in the epiphysis. Wilkins[6] (1941) reported additional cases. He stated: "I wish to stress, however, that true epiphysial dysgenesis can be differentiated with certainty from other conditions which might simulate it in a single roentgenogram only by following the stages of ossification in serial roentgenograms."

Our conceptions of disease entities undergo frequent changes as our knowledge of a disease process progresses. Much depends

[1] Draznin, S. Z., and Singer, K. Legg-Perthes' disease: A syndrome of many etiologies? With clinical and roentgenographic findings in a case of Gaucher's disease. AM. J. ROENTGENOL. & RAD. THERAPY, October, 1948, *60*, 490–497.

[2] Reiss, O., and Kato, K. Gaucher's disease; clinical study, with special reference to the roentgenography of bones. *Am. J. Dis. Child.*, 1932, *43*, 365–386.

[3] Schein, A. J., and Arkin, A. M. Hip-joint involvement in Gaucher's disease. *J. Bone & Joint Surg.*, 1942, *24*, 396–410.

[4] Arkin, A. M., and Schein, A. J. Aseptic necrosis in Gaucher's disease. *J. Bone & Joint Surg.*, 1948, *30-A*, 631–641.

[5] Albright, F. Changes simulating Legg-Perthes disease (osteochondritis deformans juvenilis) due to juvenile myxoedema. *J. Bone & Joint Surg.*, 1938, *20*, 764–769.

[6] Wilkins, L. Epiphysial dysgenesis associated with hypothyroidism. *Am. J. Dis. Child.*, 1941, *61*, 13–34.

upon individual definition of a syndrome or a disease entity. The roentgen picture alone does not constitute sufficient evidence to consider a certain condition as a syndrome or disease entity unless it be labeled a roentgen syndrome or entity. The clinical, pathological and etiological features must also be taken into consideration. Thus, in the case of Legg-Perthes' disease the clinical history, the physical signs and symptoms have often been described and a fairly constant clinical picture has resulted. These taken with the usual roentgen findings may be said to be an entity.

It can be assumed that no roentgenologist will make a final diagnosis without a knowledge of the clinical history, physical examination and pathological data of the patient. It is without doubt of value to present articles in medical journals calling attention to the fact that Legg-Perthes' disease, for instance, may resemble in its roentgenographic findings, Gaucher's disease, hypothyroidism and other conditions, so that the similarity may not be overlooked or forgotten. But, to state that Legg-Perthes' disease is not a clinical entity may lay too much stress on the fact that only in its roentgen manifestations is it simulated by those of Gaucher's disease and other conditions. This may lead young and enthusiastic roentgenologists to suggest that every case is due to hypothyroidism, Gaucher's disease or to an old reduced congenital dislocation of the hip, and so forth, ignoring the clinical findings. This would not redound to the roentgenologist's reputation for diagnostic acumen. When the roentgen findings and the clinical history, physical signs and symptoms are those of Legg-Perthes' disease the diagnosis, therefore, is a sufficiently satisfactory one.

Ralph S. Bromer, M.D.

HIRSCHSPRUNG'S DISEASE

NUMEROUS articles on megacolon had appeared in the literature prior to Hirschsprung's first report in 1888. In this report he described two cases with symptoms of constipation and meteorism and without evidence of stenosis of the colon. Later, Hirschsprung reported additional cases and he attributed the cause of the dilatation to a congenital defect, and since his report Hirschsprung's name has been attached to that type of congenital dilatation of the colon which occurs in children.[1]

During the following years since Hirschsprung's original report many attempts have been made to ascertain the exact pathogenesis of that disease and to devise satisfactory treatment, but it has only been within the last few years that real progress has been made.

Ehrenpreis[2] in 1946 produced evidence that the dilatation of the colon is not congenital, but develops weeks or months after birth and he, along with many others, classified megacolon as a dysfunction of evacuation of unknown origin. A disturbance of autonomic innervation of the colon seemed to him most probable but not proved as neurohistological investigations had given contradictory results.

In 1948 Swenson and Bill[3] reported that suitable methods of roentgenological examination reveal a "spastic" segment of colon distal to the dilated part and they concluded on clinical grounds that this obstructive narrowing is responsible for the dilatation.

Quite recently Bodian, Stephens and Ward[4] at the Hospital for Sick Children, London, England, have reported on their study of Hirschsprung's disease and idiopathic megacolon in which they employed the roentgen ray as a method of differentiation. They employed no routine preparation prior to the administration of the barium and in order to avoid the sequelae of desiccated barium in the colon, glycerine and paraffin were introduced into the barium emulsion. This was run into the bowel from an initial height of 3 feet above the table through a soft rubber catheter introduced a minimum distance into the rectum. The flow was under the immediate control of the roentgenologist and the initial filling of the rectum and rectosigmoid region was closely observed. The flow of the enema was stopped as soon as the diagnosis could be made, the flow of the enema being stopped at various stages of filling of the colon, and posteroanterior, lateral and oblique views taken in such positions as would best show the abnormalities and the rectosigmoid region. Roentgenograms were also taken immediately after evacuation.

The roentgen findings were characteristic of Hirschsprung's disease in 34 of their cases. In the chronic stage of the disease the plain film of the abdomen may show gross gaseous distention with the flaring of the ribs and the distended colon immediately below the diaphragm on both sides. During the barium enema study the rectum is filled and this appears to be normal or less than normal size. Above the rectum the diameter of the intestine narrows for a short distance which varies greatly from case to case. Above this narrowed portion the colon opens by a wide funnel into a hugely dilated and gas-filled colon. Once this dilated portion is filled, the narrowing below or distal to it may be obscured and very difficult to demonstrate. Consequently it is important that not too much barium be given so that it obscures the narrowed segment proximal to the normal rectum. It is necessary that the examiner watch with considerable care the filling of the rectum and the rectosigmoid area to observe not only the narrowed loop but to vary the position of the patient so that film studies may be made at the exact

[1] Bockus, Henry L. Gastro-enterology. Vol. II. W. B. Saunders Co., Philadelphia, 1943, p. 398.

[2] Ehrenpreis. Quoted by Bodian, Stephens and Ward.[4]

[3] Swenson and Bill. Quoted by Bodian, Stephens and Ward.[4]

[4] Bodian, M., Stephens, F. D., and Ward, B. C. H. Hirschsprung's disease and idiopathic megacolon. *Lancet*, Jan. 1, 1949, *1*, 6–11.

interval of the filling of the narrowed loop and the beginning filling of the funnel-shaped colon above it, as it is this narrowed segment of the colon in the rectosigmoid area which gives the clue in the differential diagnosis between Hirschsprung's disease and idiopathic megacolon.

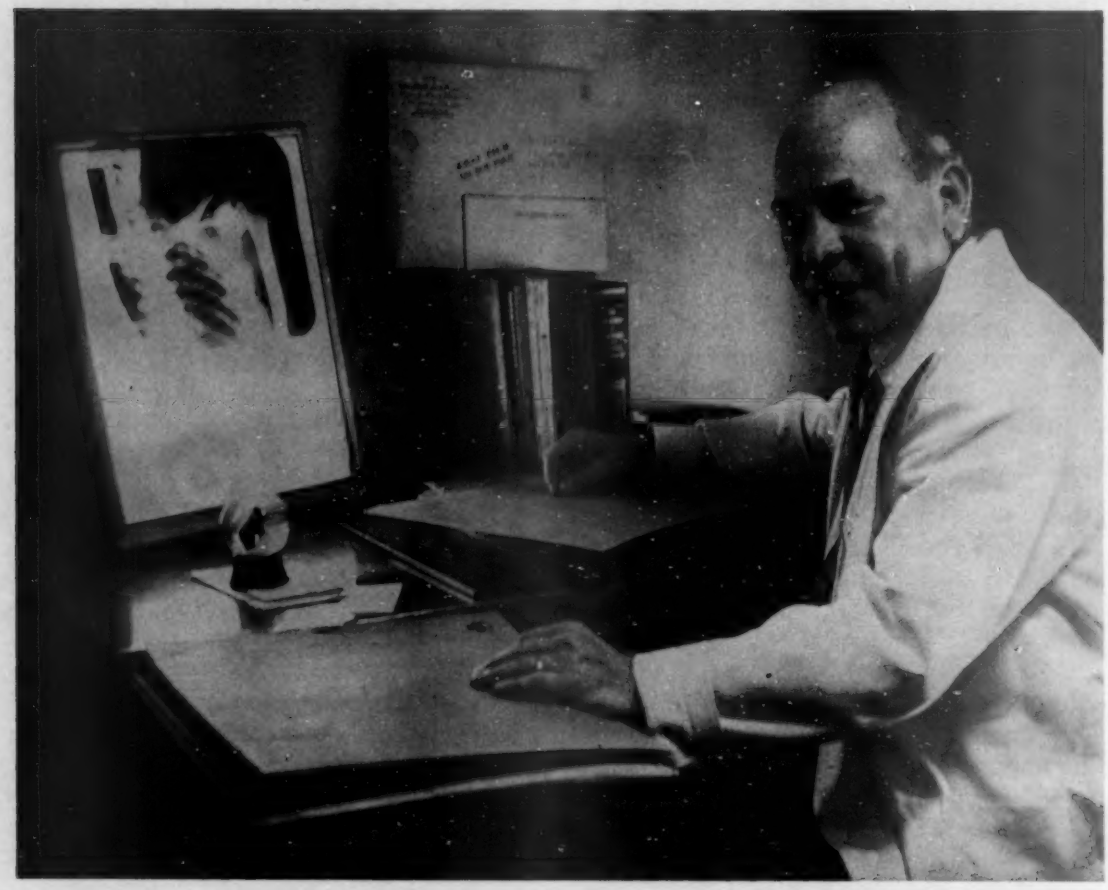
The cases of idiopathic megacolon in the study by Bodian, Stephens and Ward fell roughly into two subgroups: One group in which the distention was confined to the rectum and the distal pelvic colon forming a terminal reservoir, and a second group in which there was noted tubular dilatation which extended from the anal orifice throughout the colon. In those cases of idiopathic megacolon in which there is a terminal reservoir present, a preliminary film of the abdomen may show a portion of dilated gas-filled intestine and the barium enema reveals that the rectum and the distal pelvic colon form a pear-shaped unilocular dilated chamber extending in some cases from the anus to the xiphisternum.

In those cases which fall into the group classified as tubular dilatation, the rectum appears quite large and the pelvic colon is much longer and wider than usual and lacks its normal haustral markings, but the contour of the bowel is otherwise normal. The boundary between the normal and abnormal bowel is in this type of case ill defined.

The cause of the spasticity which is observed in the distal colon in Hirschsprung's disease was suggested by Zuelzer and Wilson[5] in their paper on "Functional intestinal obstruction on a congenital neurogenic basis in infancy" in which they reported several cases showing segmental aplasia of ganglion cells of the myenteric plexus in several infants with acute intestinal obstruction, but their findings in chronic megacolon were not uniform. Bodian and his colleagues attributed some of the discrepant findings of previous investigators to the assumption that all cases of idiopathic megacolon are Hirschsprung's disease. This group of investigators reserve the term Hirschsprung's disease for the condition in which a contracted segment of the bowel can be demonstrated roentgenologically, and in all the cases of this kind that they have examined histologically they have found complete aplasia of parasympathetic ganglion cells in the autonomic plexuses of the distal segment. Utilizing Swenson and Bill's principle of treatment by rectosigmoidectomy, they have had gratifying results in their group of cases.

The roentgenologist who so frequently sees these cases of dilatation of the colon may by careful examination definitely differentiate Hirschsprung's disease from the group of idiopathic megacolon by demonstrating the narrowed segment of the bowel in the rectosigmoid area in contrast to the idiopathic megacolon group which exhibits the terminal reservoir and the tubular dilatation of the colon. It is only by such a careful examination that true Hirschsprung's disease may be differentiated and by proper operative procedures, as suggested by Swenson and Bill, the condition relieved.

[5] Zuelzer, W. W., and Wilson, J. L. Functional intestinal obstruction on a congenital neurogenic basis in infancy. *Am. J. Dis. Child.*, 1948, *75*, 40–64.



WILLIAM GREGORY COLE
1902-1948

DR. WILLIAM GREGORY COLE died suddenly of coronary disease on April 15, 1948, while in Bermuda for a brief rest. Dr. Cole, the son of Dr. and Mrs. Lewis Gregory Cole, was born in New York City on February 1, 1902. He received his early education at Hackley School in Tarrytown, New York. He obtained his B.S. from Harvard University in 1924, and in 1928 his medical degree from the College of Physicians and Surgeons, Columbia University, and served his internship for two years. At the end of this period he entered the field of radiology under the guidance of his eminent father, Dr. Lewis Gregory Cole. They found each other stimulating collaborators. Dr. Lewis Gregory Cole tells in his recently published book "Lung Dust Lesions Versus Tuberculosis" of his son's part in interesting him in research on the effect of dust on the lung. He tells of William Gregory's putting a portable roentgen-ray machine in the back of his car and driving down to West Virginia; of his overcoming the suspicion and even animosity of the silicosis victims, and of his obtaining roentgenograms and pathological specimens, which were the basis of the elder Cole's researches in the pathology of these lesions. "Dry as dust" is an outmoded simile in any discussion of the studies of the Coles on pneumoconiosis. There is

dust, but there is also a rich storehouse of human relationships between doctors and patients, and father and son.

Dr. Cole went to Pittsfield, Massachusetts, in November, 1941, as roentgenologist to the House of Mercy Hospital where he served in that capacity until his death. He was also roentgenologist at the Hillcrest Hospital in Pittsfield and the Fairview Hospital in Great Barrington. He was a member of the Massachusetts Medical Society and had been certified by the American Board of Radiology. His application for membership in the American Roentgen Ray Society was pending at the time of his death and he was elected posthumously at the meeting of the Society in September, 1948.

During the few short years he was in Pittsfield, Dr. Cole made many true friends in the profession who will miss his keen wisdom and advice, not only in his chosen field of radiology but in various other fields pertaining to the practice of medicine. The new and modern Department of Radiology at the House of Mercy Hospital will stand as a memorial to Dr. Cole who planned and worked diligently to bring about its establishment.

Ramsay Spillman, M.D.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this section solicited promptly after the events to which they refer

MEETINGS OF ROENTGEN SOCIETIES*

UNITED STATES OF AMERICA

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. H. Dabney Kerr, University Hospital, Iowa City, Iowa. Annual meeting: Netherland Plaza Hotel, Cincinnati, Ohio, Oct. 4–7, 1949.

AMERICAN RADIUM SOCIETY
Secretary, Dr. H. F. Hare, 605 Commonwealth Ave., Boston, Mass. Annual meeting: Ambassador Hotel, Atlantic City, N. J., June 5–7, 1949.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. D. S. Childs, 607 Medical Arts Bldg., Syracuse, N. Y. Annual meeting: 1949, to be announced.

AMERICAN COLLEGE OF RADIOLOGY
Executive Secretary, William C. Stronach, 20 N. Wacker Drive, Chicago 6. Annual meeting: Chalfonte-Haddon Hall, Atlantic City, N. J., June 5, 1949.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. U. V. Portmann, Cleveland Clinic, Cleveland, Ohio, Annual Meeting: Atlantic City, N. J., June 8–10, 1949.

ALABAMA RADIOLOGICAL SOCIETY
Secretary, Dr. W. W. Anderson, Tuscaloosa, Ala. Next meeting time and place of Alabama State Medical Association.

ARKANSAS RADIOLOGICAL SOCIETY
Secretary, Dr. Fred Hames, 511 National Bldg., Pine Bluff, Ark. Meets every three months and also at time and place of State Medical Association.

BROOKLYN ROENTGEN RAY SOCIETY
Secretary, Dr. A. H. Levy, 1354 Carroll St., Brooklyn 13, N. Y. Meets monthly on fourth Tuesday, October to April.

BUFFALO RADIOLOGICAL SOCIETY
Secretary, Dr. Mario C. Gian, 610 Niagara St., Buffalo, N. Y. Meets second Monday evening each month, October to May inclusive.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. Dwight V. Needham, 608 E. Genesee St., Syracuse N. Y. Meets January, May, November.

CENTRAL OHIO RADIOLOGICAL SOCIETY
Secretary, Dr. Paul D. Meyer, Grant Hospital, Columbus, Ohio. Meets at 6:30 P.M. on second Thursday of October, December, February, April, and June at Seneca Hotel, Columbus, Ohio.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. John H. Gilmore, 720 N. Michigan Ave., Chicago 11, Ill. Meets second Thursday of each month October to April inclusive at the Palmer House.

CINCINNATI RADIOLOGICAL SOCIETY
Secretary, Dr. Eugene L. Saenger, 735 Doctors Bldg., Cincinnati 2, Ohio. Meets last Monday of each month, September to May, inclusive.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. George L. Sackett, 10515 Carnegie Ave. Cleveland 6, Ohio. Meetings at 6:30 P.M. on fourth Monday of each month from October to April.

COLORADO RADIOLOGICAL SOCIETY
Secretary, Dr. Mark S. Donovan, 306 Majestic Bldg., Denver 2, Colo. Meets third Friday of each month at Department of Radiology, Colorado School of Medicine.

CONNECTICUT VALLEY RADIOLOGIC SOCIETY
Secretary, Dr. E. W. Godfrey, 1676 Boulevard, West Hartford, Conn. Meets second Friday of October and April.

DALLAS-FORT WORTH ROENTGEN STUDY CLUB
Secretary, Dr. X. R. Hyde, Medical Arts Bldg., Fort Worth, Texas. Meets in Dallas on odd months and in Fort Worth on even months, on third Monday, 7:30 P.M.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. W. G. Belanger, Harper Hospital. Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

EAST BAY ROENTGEN SOCIETY
Secretary, Dr. Dan Tucker, 434-30th St., Oakland 9, Calif. Meets first Thursday each month at Peralta Hospital, Oakland.

FLORIDA RADIOLOGICAL SOCIETY
Secretary, Dr. F. K. Hurt, Riverside Hospital, Jacksonville, Fla. Meets twice annually, in the spring with the annual State Society meeting, and in the fall.

GEORGIA RADIOLOGICAL SOCIETY
Secretary, Dr. Robert Drane, DeRenne Apartments, Savannah, Ga. Meets in mid-winter and at annual meeting of Medical Association of Georgia in the spring.

HOUSTON X-RAY CLUB
Secretary, Dr. Curtis H. Burge, 3020 San Jacinto St., Houston 4, Texas. Meets fourth Monday each month.

RADIOLOGICAL SOCIETY OF KANSAS CITY
Secretary, Dr. Arthur B. Smith, 800 Argyle Bldg., Kansas City, Mo. Meets third Thursday of each month.

ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. Wm. DeHollander, St. John's Hospital, Springfield, Ill. Meets three times a year.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. William M. Loehr, 712 Hume-Mansur Bldg., Indianapolis 4. Meets second Sunday in May.

IOWA X-RAY CLUB
Secretary, Dr. Arthur W. Erskine, 326 Higley Bldg., Cedar Rapids, Iowa. Luncheon and business meeting during annual session of Iowa State Medical Society. Special meetings by announcement.

KANSAS RADIOLOGICAL SOCIETY
Secretary, Dr. Anthony F. Rossitto, Wichita Hospital, Wichita, Kan. Meets annually with State Medical Society.

KENTUCKY RADIOLOGICAL SOCIETY
Secretary, Dr. W. C. Martin, 321 W. Broadway, Louisville. Meets annually in Louisville on first Saturday in Apr.

LONG ISLAND RADIOLOGICAL SOCIETY
Secretary, Dr. Marcus Wiener, 1430-48th St., Brooklyn, N. Y. Meets Kings County Med. Soc. Bldg. monthly on fourth Thursday, October to May, 8:45 P.M.

LOS ANGELES RADIOLOGICAL SOCIETY
Secretary, Dr. Wybren Hiemstra, 1414 S. Hope St., Los Angeles 15, Calif. Meets second Wednesday each month at Los Angeles County Medical Assn. Building.

LOUISIANA RADIOLOGICAL SOCIETY
Secretary, Dr. J. R. Anderson, 1130 Louisiana Ave., Shreveport. Meets annually during Louisiana State Medical Society Meeting.

LOUISVILLE RADIOLOGICAL SOCIETY
Secretary, Dr. E. L. Pirkey, Louisville General Hospital, Louisville 2, Ky. Meets monthly on second Friday at Louisville General Hospital.

* Secretaries of societies not here listed are requested to send the necessary information to the Editor.

Michigan Association of Roentgenologists
Secretary, Dr. R. D. McDuff, 220 Genesee Bank Bldg., Flint 3, Mich.

Milwaukee Roentgen Ray Society
Secretary, Dr. C. A. H. Fortier, 231 W. Wisconsin Ave., Milwaukee, Wis. Meets monthly on second Monday at University Club.

Minnesota Radiological Society
Secretary, Dr. Chauncey N. Borman, 802 Medical Arts Bldg., Minneapolis 2, Minn. Two meetings yearly, one at time of Minnesota State Medical Association the other in the fall.

Nebraska Radiological Society
Secretary, Dr. Ralph C. Moore, Nebraska Methodist Hospital, Omaha 3, Nebr. Meets third Wednesday of each month, at 6 P.M. at either Omaha or Lincoln.

New England Roentgen Ray Society
Secretary, Dr. George Levene, Massachusetts Memorial Hospitals, Boston, Mass. Meets monthly on third Friday, Boston Medical Library.

New Hampshire Roentgen Ray Society
Secretary, Dr. A. C. Johnston, Elliott Community Hospital, Keene, N. H. Meets four to six times yearly.

New York Roentgen Society
Secretary, Dr. Ramsay Spillman, 115 East 61st St., New York City. Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

North Carolina Radiological Society
Secretary, Dr. J. E. Hemphill, 323 Professional Bldg., Charlotte 2, N. C. Meets in May and October.

North Dakota Radiological Society
Secretary, Dr. C. O. Heilman, 807 Broadway, Fargo. Meetings held by announcement.

Northern California Radiological Club
Secretary, Dr. C. E. Grayson, Medico-Dental Bldg., Sacramento 14, Calif. Meets at dinner last Monday, every second month, except June, July and August. Next meeting Sept. 27, 1948.

Ohio State Radiological Society
Secretary, Dr. Carroll C. Dundon, 2065 Adelbert Road, Cleveland 6, Ohio.

Oklahoma State Radiological Society
Secretary, Dr. W. E. Brown, Tulsa, Okla. Three regular meetings annually.

Oregon Radiological Society
Secretary, Dr. Boyd Isenhart, 214 Medical Dental Bldg., Portland 5, Oregon. Meets monthly 2nd Wednesday, 8:00 P.M., Library of University of Oregon Medical School.

Orleans Parish Radiological Society
Secretary, Dr. Joseph V. Schlosser, Charity Hospital, New Orleans 13, La. Meets first Tuesday of each month.

Pacific Northwest Radiological Society
Secretary, Dr. S. J. Hawley, 1320 Madison St., Seattle 4, Wash. Meets annually in May.

Pacific Roentgen Society
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association.

Pennsylvania Radiological Society
Secretary, Dr. J. M. Converse, 416 Pine St., Williamsport.

Philadelphia Roentgen Ray Society
Secretary, Dr. Arthur Finkelstein, Graduate Hospital, 19th and Lombard St. Meets first Thursday each month October to May, at 8:00 P.M., in Thomson Hall, College of Physicians.

Pittsburgh Roentgen Society
Secretary, Dr. R. P. Meader, 4002 Jenkins Arcade Pittsburgh 22, Pa. Meets 6:30 P.M. at Webster Hall Hotel on second Wednesday each month, October to May inclusive.

Queens Roentgen Ray Society
Secretary, Dr. J. E. Goldstein, 88-29 163rd St., Jamaica 3, N. Y. Meets fourth Monday of each month except during the summer.

Radiological Section, Baltimore Medical Society
Secretary, Dr. Harry A. Miller, 2452 Eutaw Place, Baltimore. Meets third Tuesday each month, September to May.

Radiological Section, Connecticut Medical Society
Secretary, Dr. Robert M. Lowman, Grace-New Haven Community Hospital, New Haven 11. Meets bimonthly second Thursday, at place selected by Secretary.

Radiological Section, District of Columbia Medical Society
Secretary, Dr. A. A. J. Den, 1801 K St., N. W., Washington, D. C. Meets Medical Society Auditorium, third Thursday, January, March, May, October at 8:00 P.M.

Radiological Section, Southern Medical Association
Secretary, Dr. Roy G. Giles, Temple, Texas.

Radiological Society of New Jersey
Secretary, Dr. Raphael Pomeranz, 31 Lincoln Park, Newark, N. J. Meets annually at time and place of State Medical Society. Mid-year meetings at place chosen by president.

Rochester Roentgen Ray Society, Rochester, N. Y.
Secretary, Dr. Ralph E. Alexander, 101 Medical Arts Bldg. Meets monthly on third Monday from October to May, inclusive, 8 P.M. at Strong Memorial Hospital.

Rocky Mountain Radiological Society
Secretary, Dr. Maurice D. Frazer, 1037 Stuart Bldg., Lincoln, Nebr. Meets Denver, Colo., August 18, 19, 20, 1949.

St. Louis Society of Radiologists
Secretary, Dr. Edwin C. Ernst, Beaumont Medical Building, St. Louis, Mo. Meets fourth Wednesday of each month, except June, July, August, and September.

San Diego Roentgen Society
Secretary, Dr. R. F. Niehaus, 1831 Fourth Ave., San Diego, Calif. Meets monthly, first Wednesday at dinner.

Section on Radiology, California Medical Association
Secretary, Dr. D. R. MacColl, 2007 Wilshire Blvd., Los Angeles 5, Calif.

Section on Radiology, Illinois State Medical Society
Secretary, Dr. Harold L. Shinall, St. Joseph's Hospital, Bloomington, Ill.

Shreveport Radiological Club
Secretary, Dr. R. W. Cooper, Charity Hospital, Shreveport, La. Meets monthly on third Wednesday, at 7:30 P.M., September to May inclusive.

South Carolina X-Ray Society
Secretary, Dr. T. A. Pitts, Baptist Hospital, Columbia, S. C. Meets in Charleston on first Thursday in November, also at the time and place of South Carolina State Medical Association.

Tennessee Radiological Society
Secretary, Dr. J. M. Frère, 707 Walnut St., Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

Texas Radiological Society
Secretary, Dr. R. P. O'Bannon, 650 Fifth Ave., Fort Worth 4, Texas. Next meeting Jan. 7–8, 1949, Fort Worth, Texas.

University of Michigan Department of Roentgenology Staff Meeting
Meets each Monday evening from September to June, at 7 P.M. at University Hospital.

University of Wisconsin Radiological Conference
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis. Meets first and third Thursdays 4:00 to 5:00 P.M., September to May inclusive. Room 203, Service Memorial Institute, 426 N. Charter St., Madison.

UTAH STATE RADIOLOGICAL SOCIETY
Secretary, Dr. Angus K. Wilson, 343 S. Main St., Salt Lake City 1, Utah. Meets third Wednesday in September, November, January, March and May.

VIRGINIA RADIOLOGICAL SOCIETY
Secretary, Dr. P. B. Parsons, Norfolk General Hospital, Norfolk, Va. Meets annually in October.

WASHINGTON STATE RADIOLOGICAL SOCIETY
Secretary, Dr. Homer V. Hartzell, 310 Stimson Bldg., Seattle 1, Wash. Meets fourth Monday each month, October through May, College Club, Seattle.

X-RAY STUDY CLUB OF SAN FRANCISCO
Secretary, Dr. Ivan J. Miller, 49 Fourth St., San Francisco 3. Meets monthly on third Thursday at 7:45 P.M., January to June at Lane Hall, Stanford University Hospital, and July to December at Langley Porter Clinic, University of California Hospital.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA
President, Dr. J. Manuel Viamonte, Hospital Mercedes, Habana, Cuba. Meets monthly in Habana.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGIA Y FISIOTERAPIA
General Secretary, Dr. D. P. Cossio, Marsella No. 11, Mexico, D. F. Meets first Monday of each month.

BRITISH EMPIRE

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE ROENTGEN SOCIETY
Medical Members' meeting held monthly on third Friday at 2:30 P.M. and Ordinary Meeting at same time on following Saturday, October to May, 32 Welbeck St., London, W.1.

FACULTY OF RADIOLOGISTS
Honorary Secretary, Dr. J. F. Bromley, 45, Lincoln's Inn Fields, London, W.C.2, England.

SECTION OF RADIOLOGY OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets third Friday each month at 4:45 P.M. at the Royal Society of Medicine, 1 Wimpole St., London.

CANADIAN ASSOCIATION OF RADIOLOGISTS
Honorary Secretary, Dr. E. M. Crawford, 2100 Marlowe Ave., Montreal 28, Que. Meetings January and June.

SECTION OF RADIOLOGY, CANADIAN MEDICAL ASSOCIATION
Secretary, Dr. C. M. Jones, Inglis St., Ext. Halifax, N. S.

SOCIÉTÉ CANADIENNE-FRANCAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES
Secretary, Dr. Origéne Dufresne, 4120 Ontario St., East, Montreal, P. Q.

AUSTRALIAN AND NEW ZEALAND ASSOCIATION OF RADIOLOGISTS
Honorary Secretary, Dr. Alan R. Colwell, 135 Macquarie St., Sydney, N.S.W.
Honorary Secretaries, State Branches:
New South Wales, Dr. E. W. Frecker, 135 Macquarie St., Sydney.
Victoria, Dr. T. L. Tyrer, 3 Lockerbie Court, East St. Kilda.
Queensland, Dr. J. Adam, 131 Wickham Terrace, Brisbane.
South Australia, Dr. B. C. Smeaton, 178 North Terrace, Adelaide.
Western Australia, Dr. A. M. Nelson, 179-B St. Georges Terrace, Perth.
New Zealand, Dr. E. G. Lynch, 12 Bolton St., Wellington.

SOUTH AMERICA

SOCIEDAD ARGENTINA DE RADIOLOGIA
Secretary, Dr. Guido Gotta, Buenos Aires, Argentina. Meetings are held monthly.

SOCIEDADE BRASILEIRA DE RADIOLOGIA MEDICA
Secretary, Dr. Nicola Caminha, Av. Mem de Sa, Rio de Janeiro, Brazil. Meets monthly, except during January, February and March.

SOCIEDADE BRASILEIRA DE RADIOTERAPIA
Secretary, Dr. Andrelino Amaral, Av. Brigadeiro Luiz Antonio, 644, São Paulo, Brazil. Meets monthly on second Tuesday at 9 P.M. in São Paulo at Av. Brigadeiro Luiz Antonio, 644.

SOCIEDAD PERUANA DE RADIOLOGIA
Secretary, Dr. Julio Bedoya Paredes, Apartado, 2306, Lima, Peru. Meets monthly except during January, February and March, at Asociación Médica Peruana "Daniel A. Carrión," Villalta, 218, Lima.

SOCIEDAD DE RADIOLOGICA, CANCEROLOGIA Y FISICA MEDICA DEL URUGUAY
Secretary, Dr. Arias Bellini.

CONTINENTAL EUROPE

SOCIÉTÉ BELGE DE RADIOLOGIE
General Secretary, Dr. S. Masy, 111 Avenue des Alliés, Louvain, Belgium. Meets monthly, second Sunday at Maison des Médecins, Brussels.

CESKOSLOVENSKÁ SPOLEČNOST PRO RÖNTGENOLOGII A RADIOLOGII V PRAZE
Secretary, Dr. Roman Bláha, Praha XII, stát. nemocnice, Czechoslovakia. Meets monthly except during July, August, and September. Annual general meeting.

POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. L. Zgliczynski, 59 Nowogrodzka St., Warsaw, Poland. Next meeting, Krakow, June 2 and 3, 1949.

GDANSK SECTION, POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. A. Smigielska, Akademia Lekarska, Gdansk. Meets monthly last Sunday at 10.30, X-Ray Dept., Akademia Gdansk.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. L. Zgliczynski, 59 Nowogrodzka St., Warsaw, Poland. Meets monthly.

SOCIETATEA ROMANA DE RADIOLOGIE SI ELECTROLOGIE
Secretary, Dr. Oscar Meller, Str. Banual Mărăcine, 30, S. I., Bucuresti, Roumania. Meets second Monday in every month with the exception of July and August.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD. USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson. Meets annually.

LENINGRAD ROENTGEN RAY SOCIETY
Secretaries, Drs. S. G. Simonson and G. A. Gusterin. Meets monthly, first Monday at 8 o'clock, State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky. Meets monthly, first Monday, 8 P.M.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association.

SOCIEDAD ESPANOLA DE RADIOLOGIA Y ELECTROLOGIA
Secretary, Dr. J. Martin-Crespo, Fuencarral, 7. Madrid, Spain. Meets monthly in Madrid.

SCHWEIZERISCHE RÖNTGEN-GESELLSCHAFT (SOCIÉTÉ SUISSE DE RADIOLOGIE)
President, Dr. H. E. Walther, Gloriastr. 14, Zürich, Switzerland.

SOCIETA ITALIANA DI RADIOLOGIA MEDICA
Secretary, Prof. Mario Ponzio, Ospedale Mauriziano Torino, Italy. Meets biannually.

THIRD INTER-AMERICAN CONGRESS OF RADIOLOGY

The Third Inter-American Congress of Radiology will be held November 11 to 17, 1949, in Santiago and in Vina del Mar, Chile. The inscription fee of twenty dollars should be sent to Dr. James T. Case, 55 East Washington St., Chicago 2, Illinois. More than one hundred American radiologists have expressed their desire to attend the meeting and are investigating expenses, travel itineraries, reservations, etc. Information concerning these matters will be sent on application. Whether or not those who inscribe as members actually attend the Congress, they will be listed as members and receive a copy of the Proceedings of the Congress. Arrangements are in process for the United States participating in the program. Official topics for discussion, as previously published, are as follows:

A. Radiological Exploration of the Cardiovascular System with Opaque Material.

The official presentation should refer essentially to radiological exploration of the heart and large blood vessels. Inclusion in the official presentation of the peripheral vascular system will be optional.

B. Diagnosis and Simple Radiological Exploration of the Skull.

With the object of facilitating its development, this subject has been divided into three official presentations:

1. a) Skull in general.
   b) Sella turcica.
2. c) Orbits.
   d) Paranasal cavities.
3. e) Temporal bones.

These official presentations should be short communications, read without introducing individual cases, being a résumé of the experience of the country of the speaker. Official speakers may bring all the material they wish; preferably full-size originals for exhibition in the Scientific Exhibits. The Executive Committee requests that collaborations be fundamentally objective, and insists upon the exhibit, making the verbal part as brief as possible.

C. Radiation Treatment of Cancer of the Tongue.

D. Radiation Treatment of Cancer of the Cervix.

Official presentations on these two subjects should comprise essentially the following parts:

1. Radiotherapy Technique.
2. Immediate and Subsequent Reactions, and
3. Case Reports Illustrating Clinical Degree and the Histological Type of Cancer.

In addition there will be opportunity for so-called "free papers." These papers are to be presented in the Section on Scientific Exhibits.

Facilities are being provided for earphones so that those in attendance will be able to hear a paper read in the language in which it is being spoken or a simultaneously read translation. Our Chilean colleagues have pledged themselves to perform a tremendous amount of work to make the Congress proceedings available to all listeners.

Those who definitely decide to attend the meeting should communicate with the undersigned to receive complete instructions as to the necessary documents, such as passports, visas, health certificates, etc. Further information will be published as it becomes available. At the moment it is urged that all who wish to participate in the program let us know as early as possible.

James T. Case, M.D.
Regional Secretary
for the United States

SIXTH INTERNATIONAL CONGRESS OF RADIOLOGY

The Sixth International Congress of Radiology will be held in London from July 23 to 30, 1950, with Congress headquarters at the Central Hall, Westminster. The address of the Central Office is: 45 Lincoln's Inn Fields, London, W.C. 2. The Officers of the Congress are:

President—Dr. Ralston Paterson.

President Emeritus—Dr. A. E. Barclay.

Vice-Presidents—Dr. S. Cochrane Shanks, Prof. B. W. Windeyer, Prof. W. V. Mayneord, Dr. F. Gordon Spear.

Treasurer—Dr. H. Graham Hodgson.

Secretary-General—Dr. J. W. McLaren.

The program will be divided into four sections, each under the direction of a Vice-President, as follows:

Radiologic Diagnosis—Dr. S. Cochrane Shanks.

Radiotherapy—Prof. B. W. Windeyer.

Radiophysics—Prof. W. V. Mayneord.

Radiobiology—Dr. F. Gordon Spear.

The American Delegation is composed of representatives appointed by the four national radiological societies and by the Section on Radiology of the American Medical Association. The Members are:

American Roentgen Ray Society: Delegate, Dr. B. R. Kirklin, Mayo Clinic, Rochester, Minnesota; Alternate, Dr. E. L. Jenkinson, St. Luke's Hospital, Chicago 5, Illinois.

Radiological Society of North America: Dr. F. W. O'Brien, 465 Beacon Street, Boston 15, Massachusetts; Alternate, Dr. John D. Camp, Mayo Clinic, Rochester, Minnesota.

American Radium Society: Delegate, Dr. Douglas Quick, 350 Park Avenue, New York, N. Y.; Alternate, Dr. F. W. O'Brien, 465 Beacon Street, Boston 15, Mass.

Section on Radiology, American Medical Association: Delegate, Dr. U. V. Portmann, Cleveland Clinic, Cleveland 6, Ohio; Alternate, Dr. Edwin C. Ernst, 3720 Washington Boulevard, St. Louis, Missouri.

American College of Radiology: Delegate, Dr. Ross Golden, Presbyterian Hospital, New York 32, New York; Alternate, Dr. B. P. Widmann, 250 South 18th Street, Philadelphia 3, Pennsylvania.

At a meeting of the Delegation held at the Palmer House, Chicago on September 14, 1948, under the Chairmanship of Dr. Arthur C. Christie, President of the Fifth International Congress, Ross Golden was made Chairman of the American Delegation.

Travel Arrangements. The Officers of the Sixth International Congress in London selected Thomas Cook and Son as the official travel agency of this Congress. The American Delegation has also selected Thomas Cook and Son as the official travel agency, believing that the best coordination of arrangements on both sides of the Atlantic could be secured in this way. Thomas Cook and Son will make a reservation of space so that American members of the Congress who desire to do so may travel across the Atlantic as a group. Inquiries and reservations should be addressed to Mr. C. L. Hill, Thomas Cook and Son, 587 Fifth Avenue, New York 17, New York. *However, any individual is at liberty to make arrangements with a travel agency of his own choosing.* The officials of the Congress in London, as well as representatives of several travel agencies, have expressed the opinion that transatlantic travel will be unusually heavy in the summer of 1950, and have emphasized the importance of making *round trip reservations* as early as possible.

The Program. Details concerning the organization of the program have not yet been received from the London office of the Congress. They will be published later. Applications for a place on the program should be addressed to Dr. Ross Golden, Presbyterian Hospital, 622 West 168th Street, New York 32, New York.

REPORT OF A CASE OF AN ANOMALOUS LOBE OF THE LIVER

To the Editor:

The paper, "Report of a Case of an Anomalous Lobe of the Liver," by Norris M. Hardisty, Edward A. Kearney, and Frank P. Brooks, on page 486 of the October issue of the JOURNAL attracted my special interest, because the illustrations given resembled very much those of a number of cases which I had published many years ago. Unfortunately, I cannot agree with the interpretation the authors have given their findings.

In short, they have found a sharply defined, rounded soft tissue shadow, projecting from the right diaphragmatic contour into the pleural cavity. Diagnostic pneumo-

peritoneum showed that the soft tissue mass was part of the liver, and lying below a thinned part of the diaphragm. Subsequent operation confirmed the roentgen findings and revealed that apparently normal liver tissue was forming the mass. Roentgen examination after repair of the incision in the thinned area of the diaphragm showed that the projection was now smaller than preoperatively.

The fact that the diaphragm at the site of prominence was thinned should have indicated that a diaphragmatic hernia was present, containing liver. It is hardly conceivable how an anomalous lobe of the liver could cause atrophy of the diaphragm. On the other hand, after repair of the hernia the prominence was markedly reduced in size, and it is just as difficult to understand how suturing the diaphragm would reduce an anomalous liver lobe to half its original size.

Right diaphragmatic hernias having as only content a comparatively small portion of the—otherwise normal—liver are not extremely rare. I have reported 4 such cases in the *Fortschritte auf dem Gebiete der Röntgenstrahlen* in 1923, vol. 30, p. 305 and 473, and another case of "Hernia diaphragmatica dextra hepatis" in the *Fortschritte*, 1926, vol. 34, p. 481, and have discussed the differential diagnosis in *Wiener Archiv für innere Medizin*, 1923, vol. 6, p. 445, giving extensive literature references up to that date. Since that time I continue to see the condition at not too infrequent intervals. Originally I used diagnostic pneumoperitoneum to satisfy myself that the mass was continuous with the liver, and that the hernia usually was a true one; that is, that the serous membranes of pleura and peritoneum were preserved at least, even if the diaphragm muscle was defective to a greater or lesser extent (the last published case, however, was a false hernia, so that the pneumoperitoneum resulted in right pneumothorax). Eventually, however, I became convinced that the isolated paradoxical movement of the prominent part of the diaphragmatic contour (while the rest of it moves in a normal direction) is sufficient evidence for the presence of diaphragmatic hernia. But I have made it a point that nothing short of Müller's experiment (attempted forceful inspiration, while the glottis—or for that matter, mouth and nose —are closed) or one of its modifications is a reliable function test of the diaphragm. Merely forceful inspiration will disclose only the higher degrees of functional impairment of the diaphragm.

The anatomical literature on such hernias of the right diaphragm with liver as the only content is somewhat more abundant than the roentgenological literature. The liver is readily molded by the surrounding structures. The difference between abdominal and pleural pressures forces the adjacent part of the liver into the diaphragmatic defect and in some instances makes it mushroom on the upper surface of the diaphragm.

At postmortem examination a mushroom-like or peg-like process of the liver is found, fitting snugly into the pocket of the right pleural cavity. This prominent part of the liver shows the normal lobular architecture with central veins and bile ducts.

Such hernia diaphragmatica dextra hepatis is usually asymptomatic and only an incidental finding during a roentgen examination made for some other reason. Only in a minority of cases there are symptoms which could be referred to the hernia. There are, however, never complications requiring surgery, such as is the case if hollow viscus or omentum is the content of a diaphragmatic hernia.

Hernia diaphragmatica dextra hepatis is either acquired or—more often—congenital. Since in the histories of most adults some trauma can be found which may possibly be etiological, the typical or atypical location of the hernia will give a hint as to whether it is due to developmental abnormality or to injury. At any rate, such hernias have been described in infants, which is always a strong indication that the abnormality is developmental.

Incidentally, such liver hernias are not confined to the right leaf of the diaphragm. Keith (*Brit. M. J.*, 1910, p. 1297) has found

liver herniated into the pericardial cavity, and other authors have described similar abnormalities in dogs.

LEO REICH, M.D.

2242 Independence St.
Phoenix, Arizona

To the Editor:

In reply to Doctor Reich's letter commenting on the "Case Report of Anomalous Lobe of the Liver," I wish to state that it is, perhaps, noteworthy that so far, he is the only one who has seen fit to indulge in written comment on the report. I am unable to read German and it is entirely possible that certain foreign publications have not been included in our list of references.

It would appear that Doctor Reich and we are looking at the problem from different angles. I feel that Doctor Reich is entitled to his opinion if he chooses to consider the condition as a form of hernia involving the diaphragm. The other authors and I considered the primary condition to be an anomalous lobe of the liver and the overlying thinning of the diaphragm to be of secondary moment. The fact that the diaphragm was found to be intact after pneumoperitoneum and surgery definitely denies the existence of a hernia and definitely establishes the presence of a localized eventration. The fact that herniation of the liver through the diaphragm does occur is not questioned and the fact remains in this case that only that portion of the diaphragm overlying this anomalous lobe seemed to be thin and eventrated. We were definitely of the opinion that this anomalous and pedunculated liver lobe was the probable cause of the local thinning and stretching of the diaphragm. At operation the anomalous lobe was not protruding through the diaphragm in the ordinary sense but was pressing it upward. The thinned diaphragm was shortened by plicating it and suturing it. We expected that the tightened diaphragm would flatten this lobe, at least for a time after operation.

In this instance, I fail to appreciate the premise that the diaphragm was locally weak and that the liver forced a portion of its substance as a pedunculated mass through the diaphragmatic weakness. There was no break in the diaphragm and, therefore, no hernia.

N. M. HARDISTY
Captain (MC) USN

U. S. Naval Hospital
St. Albans 12, N. Y.

LOS ANGELES RADIOLOGICAL SOCIETY

At a recent meeting of the Los Angeles Radiological Society the following officers were elected to serve for the ensuing year: *President*, Dr. John McAtee; *Vice-President*, Dr. Leo Levi; *Secretary*, Dr. Wybren Hiemstra; Treasurer, Dr. Wilbur Bailey.

ROCHESTER ROENTGEN RAY SOCIETY

At the annual meeting of the Rochester (N. Y.) Roentgen Ray Society in December, 1948, the following officers were elected for the coming year: *President*, Dr. George H. Ramsey; *Vice-President*, Dr. E. Forrest Merrill; *Secretary-Treasurer*, Dr. Ralph E. Alexander.

CORRECTION

The need for a correction in the paper by A. U. Desjardins, F. A. Figi, and L. M. Vaughan, "Roentgen Treatment for Extensive Epithelioma of the Larynx," AM. J. ROENTGENOL. & RAD. THERAPY, July, 1948, *60*, 29–36, has been discovered by the authors. The corrections have to do with the first two sentences of the last paragraph of the paper, and should read as follows:

From Table 1 it may be seen that, out of 139 cases in the entire series, 71 patients were treated between 1936 and 1942, inclusive; of these we have not been able to obtain information concerning 3 cases (although the probable outcome in these 3 cases is recorded in Table 1). This leaves 68 patients in this series who were treated during this period and of whom 14 are living five years or more since their treatment at the Clinic.

Vol. 61, No. 2

ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

Department Editor: George M. Wyatt, M.D., 1835 Eye St., N.W., Washington 6, D. C.

INDEX TO ABSTRACTS

ROENTGEN DIAGNOSIS

Head

Weens, H. S.: Calcified intracranial tuberculomas 262

Baily, O. T., Ingraham, F. D., Neuhauser, E. B. D., and Cobb, C. A., Jr.: Fibrin film in neurosurgery, further studies 263

Oscherwitz, D., and Davidoff, L. M.: Midline calcified intracranial aneurysm between occipital lobes 263

Coleman, C. C., and Troland, C. E.: Congenital atresia of the foramina of Luschka and Magendie 263

Ecker, A.: Upward transtentorial herniation of the brain stem and cerebellum due to tumor of the posterior fossa 264

Torkildsen, A.: Spontaneous rupture of cerebral ventricles 264

List, C. F., and Hodges, F. J.: Differential diagnosis of intracranial neoplasms by cerebral angiography 265

Lindgren, E.: Technique of direct (percutaneous) cerebral angiography 266

Neck and Chest

Neuhauser, E. B. D., and Berenberg, W.: Cardio-esophageal relaxation as a cause of vomiting in infants 266

Kristoff, F. V., and Dratz, H. M.: Minor fractures of cervical laminae simulating ruptured cervical disk 267

Bucy, P. C., and Ritchey, H.: Klippel-Feil's syndrome associated with compression of the spinal cord by an extradural hemangiolipoma 267

Seldin, D. W., Kaplan, H. S., and Bunting, H.: Rheumatic pneumonia 268

Garland, L. H.: Pulmonary sarcoidosis 268

Greening, R. R., and Menville, L. J.: Roentgen findings in torulosis 269

Jamison, H. W., and Carter, R. A.: Roentgen findings in early coccidioidomycosis 270

Hollingsworth, R. K.: Bronchiogenic carcinoma 271

Heublein, G. W., and Gilfillan, C. D. N.: Practical technic for visualization of the bronchial tree 272

Lam, C. R.: Pericardial celomic cysts 272

Sosman, M. C.: Venous catheterization of the heart. I 273

Dexter, L.: Venous catheterization of the heart. II 273

Holt, J. F.: Epipericardial fat shadows in differential diagnosis 274

Batt, R. C.: Roentgenkymographic study of the heart in myasthenia gravis 274

Clark, S. B., and Koenig, E. C.: Aortic aneurysm secondary to coarctation 275

O'Loughlin, B. J.: Study of 24,615 separation chest roentgenograms 275

Epstein, B. S.: Rheumatic mitral valve disease without cardiac enlargement 275

Ungerleider, H. E.: Cardiac enlargement 275

Abdomen

Gershon-Cohen, J.: Duodenal mechanism regulating the motor and secretory activity of the stomach 277

Ould, C. L., and Dailey, M. E.: Simultaneous radiographic and gastroscopic examination of the stomach 277

Zanca, P.: Gastrocolic fistula complicating carcinoma of the colon 278

Euphrat, E. J.: Roentgen features of mucocele of the appendix 278

Brewer, A. A.: Cholecystography 278

Rigler, L. G., and Mixer, H. W.: Cholangiography and biliary regurgitation 279

Gynecology and Obstetrics

Scarpellino, L. A.: Cephalopelvimetry 279

Genitourinary System

Myers, L. A.: Range of usefulness of intravenous pyelography 280

Nervous System

Scoville, W. B., Moretz, W. H., and Hankins, W. D.: Discrepancies in myelography 280

Denny-Brown, D.: Primary sensory neuropathy with muscular changes associated with carcinoma 281

Skeletal System

Gilmore, J. H., and Mahan, T. K.: Case of acromegaly presenting specific roentgenographic changes 281

GALLUCCIO, A. C.: Observations on gunshot fractures of mandible 281
COOPER, G., JR., ADAIR, N., and PATTERSON, W. M.: Familial osseous atrophy 281
RUSSO, P. E.: Malignant melanoma in infancy 282

ROENTGEN AND RADIUM THERAPY

McINDOE, A. H., FORBES, R., and WINDEYER, B. W.: Symposium: radiation necrosis 282
CROSS, J. E., GURALNICK, E., and DALAND, E. M.: Carcinoma of the lip 283
RICHARDSON, W., and ROBBINS, L. L.: Treatment of pylocythemia vera by spray irradiation 284
POHLE, E. A., and TOMLINSON, C.: Roentgen therapy in traumatic myositis ossificans 284
DEL REGATO, J. A.: Role of transvaginal roentgen therapy in treatment of carcinoma of cervix 285
SAUER, H. R., WATSON, E. M., and BURKE, E. M.: Tumors of the testicle 285
BERMAN, L., and AXELROD, A.: Effect of urethane on malignant diseases 286
HERRMANN, J. B., ADAIR, F. E., and WOODARD, HELEN Q.: Effect of estrogenic hormone on advanced carcinoma of female breast .. 286

MISCELLANEOUS

MARTIN, J. H.: Radiation doses received by skin of a patient during routine diagnostic x-ray examinations 286
MITCHELL, J. S.: Experiments on mechanism of biological action of fast neutrons using summation method for lethal effects in mice 287
LEWIS, MARGARET, R.: In vivo staining and retardation of tumors in mice by acridine compounds 287
LASNITZKI, ILSE: Quantitative analysis of direct and indirect action of x radiation on malignant cells 287
WOLFF, BRIGITTE, and ELLIS, F.: Quantitative histological analysis of radiation effects in human carcinomata 288
HOWARTH, F.: Isotopes and radiation hazards 288
MOORE, F. D.: Use of isotopes in surgical research 288
ELKIN, D. C., COOPER, F. W., RORHER, R. H., MILLER, W. B., SHEA, P., and DENNIS, E. W.: Study of peripheral vascular disease with radioactive isotopes 289
SIEVERT, R. M.: Tolerance dose and prevention of injuries caused by ionizing radiations 289

ROENTGEN DIAGNOSIS

HEAD

WEENS, H. S. Calcified intracranial tuberculomas. *J. Pediat.*, Sept., 1948, *33*, 328–335.

A recent review by Wilson and Bruce indicates that intracranial tuberculomas constitute 3.5 per cent of verified brain tumors. About one-half of the cases occurred in patients under ten years of age. Calcifications occur infrequently in these lesions. This is contrary to most tuberculous lesions. Since surgical removal of these tumors may be of value it is important to be able to identify them.

The author reports 3 cases in children with illustrative films. The diagnosis was proved in only 1 of the 3 cases. Calcified tuberculomas of the brain vary in size from a few millimeters to 2–3 cm. The lesions are usually solitary, but may be multiple. One of the author's cases had eleven tuberculomas which is more than has ever been reported.

A characteristic roentgen appearance of the calcium deposits in tuberculomas, based on their gross shell-like structure, is described. The calcifications are homogeneous in the center with lace-like angular margins. In some cases small spicules of calcium seem to be separated from the calcified center. Among the other lesions to be considered in a differential diagnosis are craniopharyngiomas, and angiomas. In craniopharyngiomas the calcifications are in the region of the pituitary fossa which is usually enlarged. Calcifications in angiomas usually have a typical double contour with a tortuous racemose pattern. Characteristically they are found in the occipital area. The calcification in subdural hematomas is usually strandlike and close to the inner table of the skull. Ependymomas are difficult to distinguish from tuberculomas by roentgen examination.

The calcifications in tuberous sclerosis are also to be considered in the differential diagnosis. These are usually smooth and discrete and in close relationship to the ventricular system. The cutaneous manifestations of this syndrome help to differentiate it.

The calcifications found in toxoplasmosis may be differentiated by their small size and the associated chorioretinitis and hydrocephalus.

Among rarer causes of intracerebral calcifications are bilateral symmetrical calcifications of the basal ganglia. Tuberculomas may be entirely asymptomatic.—*Rolfe M. Harvey, M.D.*

Baily, Orville T., Ingraham, Franc D., Neuhauser, Edward B. D., and Cobb, Cully A., Jr. Fibrin film in neurosurgery, further studies; the insertion of fibrin film between the sutured dura and the intact leptomeninges; the effect of roentgen therapy on tissue reactions to fibrin film. *J. Neurosurg.*, Sept., 1947, *4*, 465–471.

In operations where the brain and dura are traumatized or sections of dura are removed, it is desirable to close the dural defect with fibrin film. To test whether this material should be used following intracranial operations in which the dura is completely closed after little manipulation of the brain and leptomeninges, the authors have performed temporoparietal craniotomies in monkeys with and without insertion of fibrin film under the sutured dura. These experiments show that in the monkey uncomplicated craniotomies produce adhesions under the sutures used to close the dura. Fibrin film prevents this complication.

It is often desirable to use fibrin film in patients who may later require roentgen therapy. The possibility that roentgen rays may change the fibrin film itself or the reaction of tissues to it made it desirable to study the effect of roentgen rays on the tissue reaction to this material. A strip of sterilized fibrin film was moistened with saline and then exposed to the contact roentgen therapy apparatus. The total roentgen dosage was 8,000 r (measured in air). This fibrin film was then submitted to the tests which have been used to standardize this material. The roentgen rays could not be said to have changed the physical characteristics of the film. Experimental studies on monkeys and also inspection of operative wounds and autopsy material of human subjects showed that roentgen therapy in the doses used for treatment has no detectable effect on fibrin film or the reaction of the meninges to this material.—*K. K. Latteier, M.D.*

Oscherwitz, Daniel, and Davidoff, Leo M. Midline calcified intracranial aneurysm between occipital lobes; report of a case. *J. Neurosurg.*, Nov., 1947, *4*, 539–541.

Intracranial aneurysms nearly always arise from arteries at the base of the brain in the vicinity of the circle of Willis. In rare instances they may be located out along the larger branches of the circle and lie imbedded in the brain substance. The authors report the occurrence of a calcified aneurysm situated in the midline between the occipital lobes. The patient, a female, aged twenty-seven, complained of headaches of nine months' duration and intermittent blurring of vision. Neurological examination was entirely negative. Roentgenograms of the skull revealed a large, round and somewhat irregular cyst-like mass with calcified borders measuring 3.5 cm. in diameter lying in the midline just posterior and superior to the pineal gland. Ventriculograms revealed a normal ventricular system except for a slight indentation on the inner aspects of both posterior horns. Operation demonstrated a calcified aneurysm lying between the occipital lobes and probably representing an arteriovenous aneurysm of the vein of Galen and the branches of the circle of Willis.

The literature revealed only 4 cases of vascular anomalies similar to this case; 2 of these were found in infants. Calcification was also present in only one of these cases.—*K. K. Latteier, M.D.*

Coleman, Claude C., and Troland, Charles E. Congenital atresia of the foramina of Luschka and Magendie; with report of two cases of surgical cure. *J. Neurosurg.*, Jan., 1948, *5*, 84–88.

An excellent presentation of the entire subject of atresia of the foramina of Luschka and Magendie was given by Taggart and Walker in 1942. They reviewed the literature and detailed the development of these foramina and the vermis of the cerebellum. On the basis of these studies, they presented a roentgenographic picture that is pathognomonic of the condition. Coleman and Troland present 2 additional cases which do not show these typical findings of the impression of the confluent and lateral sinuses on the parietal bone and a high inion. In the first case, a fourteen month old female infant, the roentgenograms showed marked increase in the size of the calvarium, and

convolutional atrophy that was most marked in the parietal and occipital regions. The inion was in approximately normal position. The second case, that of a seventeen year old white male, showed marked convolutional atrophy with a large cranial vault but no widening of the sutures. Ventriculography revealed dilatation of both lateral ventricles and the 3rd ventricle. There was no air in the 4th ventricle and the impression was that of a posterior fossa lesion, probably congenital.

It is obvious that equilibrium must be established between the production of fluid in the ventricles and its escape into the subarachnoid system for this condition to be compatible with life. It is probable that in the cases reported here, this equilibrium was established early enough to permit posterior migration of the venous sinuses. Surgical treatment should be performed as soon as possible in order to prevent cortical atrophy.—*K. K. Latteier, M.D.*

ECKER, ARTHUR. Upward transtentorial herniation of the brain stem and cerebellum due to tumor of the posterior fossa; with special note on tumors of the acoustic nerve. *J. Neurosurg.*, Jan., 1948, *5*, 51–61.

Localized increases of intracranial pressure commonly displace parts of the brain in relation to both the skull and its dural partitions. Data from the literature and 2 illustrative cases indicate an upward herniation of the brain stem and cerebellum through the incisura tentorii in most cases of posterior fossa tumor. Such herniation might be called the inverted tentorial pressure cone or upward transtentorial herniation. Identical ventriculograms may be obtained in cases of tumor of the cerebellum, pons or floor of the third ventricle. As an illustration the author presents the case history of a two and a half year old child where ventriculography revealed huge bilateral dilatation of the lateral ventricles and of the anterior aspect of the 3rd ventricle. There seemed to be a large space-occupying mass in the posteroinferior portion of the 3rd ventricle, with complete blocking of the aqueduct at its origin. Third ventriculostomy was performed, but no tumor was seen in the floor of the 3rd ventricle. Later a solid cerebellar tumor was found in the midline between the cerebellar tonsils. Autopsy revealed that the rostral portion of the cerebellum was pushed upwards through the tentorial notch. Furthermore, the cerebral peduncles had been displaced upward, thus accounting for the defect on the posterior portion of the 3rd ventricle.

In acoustic nerve tumors, bulging of and herniation through the tentorium may compress the inferior surface of the temporal lobe so as to obliterate the lumen of the temporal ventricular horn. It may also cause lateral compression of the lower portion of the 3rd ventricle, simulating in the lateral ventriculogram a tumor of the 3rd ventricle. Finally, it may elevate the first portion of the middle cerebral artery. The roentgenograms of the skull in the case of acoustic nerve tumor described by the author suggested that the left internal auditory canal was larger than the right and that the pineal body was calcified and displaced very slightly upward. Despite the use of special maneuvers, there resulted no filling with air of the inferior portion of the 3rd ventricle, aqueduct or 4th ventricle. Later an autopsy revealed a typical left acoustic neurinoma. It had displaced the brain stem and cerebellum to the right and upward.

At the time of autopsy there was no immediate explanation for the non-filling of the inferior and posterior aspects of the 3rd ventricle. Further study of the lateral view of the ventriculogram revealed an apparent round defect, convex upward, simulating a tumor in the lower three-fourths of the 3rd ventricle and identical with that of another case of tumor of the pons. Secondly, the left temporal horn was not filled at all. The tumor in this case caused complete obliteration of both the left temporal horn and the lower three-fourths of the 3rd ventricle.—*K. K. Latteier, M.D.*

TORKILDSEN, ARNE. Spontaneous rupture of the cerebral ventricles. *J. Neurosurg.*, July, 1948, *5*, 327–339.

Relative intraventricular hypertension may result when resorption of the cerebrospinal fluid does not equal the rate of production. With occlusion of the foramina of Monro, a relative hypertension exists within the lateral ventricles, and with occlusion of the Sylvian aqueduct, relative hypertension exists within the lateral ventricles and the 3rd ventricle as compared with the pressure in the subarachnoid space. Under such abnormal tension a rupture of the ventricular wall may take place. The result of such a rupture depends entirely upon the details concerning its location and its relationship to the membranes covering the central nervous system. Two favored locations

for the breakdown of the ventricular wall seem to be the mesial wall of the temporal horn where it joins the posterior horn and the body of the lateral ventricle, and the anterior or posterior wall of the 3rd ventricle.

The author describes 5 cases of spontaneous rupture of the cerebral ventricular system. In 4 cases the rupture resulted in the formation of a cyst occupying the interpeduncular space, extending below the tentorium and covering the quadrigeminal plate. One case differs from the others inasmuch as the rupture did not create a cyst below the tentorium. After the spontaneous rupture the cerebrospinal fluid filled the supratentorial subdural space on the left side, resulting in an accumulation of the cerebrospinal fluid causing cerebral compression.

Spontaneous rupture of the cerebral ventricles is a pathological anatomical condition which is easily diagnosed by ventriculography. The presence of cyst formation frequently indicates a pathological condition that can be treated advantageously by ventriculocisternostomy.—*K. K. Latteier, M.D.*

List, Carl F., and Hodges, Fred J. Differential diagnosis of intracranial neoplasms by cerebral angiography. *Radiology*, May, 1947, *48*, 493–508.

In a series of 125 patients with intracranial tumor subjected to angiography at the University of Michigan Hospital a special vascular pattern was observed in the angioma, meningioma and glioblastoma groups as well as in certain types of astrocytoma.

A. *Angioma Group* (8 cases).

1. Arteriovenous malformations (6 cases).

By angiography there can be demonstrated one or several enlarged and unusually tortuous arteries leading to a tangle of smaller vessels forming a more or less well defined mass from which one or more greatly dilated redundant veins emerge. The entire malformation fills during the arterial phase of angiography. Arteriovenous malformations may be bilateral and most frequently involve anterior and middle cerebral arteries. The uninvolved cerebral vessels are not displaced. Associated cardiac hypertrophy and enlargement is occasionally demonstrated.

2. Cavernous angiomas (2 cases).

These rather rare lesions usually are of small size. Angiography has been disappointing in 2 cases.

3. Angioblastomas.

These occur almost exclusively in the cerebellum and have not been studied by angiography.

B. *Meningioma Group* (20 cases).

Meningiomas possess a rich blood supply derived from the external carotid system and from the internal carotid (and vertebral) system. A positive image of the dural blood supply can be obtained by arteriography of the external carotid artery. Following injection of the internal carotid artery, the cortical arteries in contact with the tumor appear to be distended and separated from one another, whereas the arteries of the adjacent compressed brain are crowded together and form a concentrically arranged corona around the lesion. In addition, there are seen one or multiple newly formed tumor vessels. The latter are usually rather small arteries splitting into fine branches within the meningioma and their appearance by angiography has been compared to a paint brush or flower spray. On the venogram, tumor veins appear as large short veins with many tributaries, and they tend to outline the circumference of the growth. A typical feature is the diffuse uniform or slightly mottled opacity of the tumor attributed to visualization of a fine network of vessels of capillary or near capillary size.

Diffuse radiopacity may be visible in the arterial phase (1–1.5 sec.) in meningiomas near the carotid siphon whereas it appears in the venous phase (3–5 sec.) in tumors located elsewhere.

C. *Glioblastoma* (55 cases).

Due to the infiltrating manner of tumor growth displacement of cerebral vessels tends to be more diffuse and less profound than with meningiomas of comparable size. Two types of special vascular pattern are seen in glioblastoma. The first is an irregular network of fine criss-crossing vessels and a few larger sinusoid vessels which produce lacunar dilatations with spiral or corkscrew patterns. The second is characterized by a very coarse and bizarre vascular pattern resembling an arteriovenous malformation. The large malformed vessels, probably sinsoids and veins, may form spirals or arrange themselves in parallel layers in the tumor. Well defined aberrant arteries and ef-

ferent veins, characteristic of arteriovenous malformations are not seen in glioblastomas. Some glioblastomas having necrotic or cystic centers are similar to meningiomas in appearance.

D. *Astrocytomas* (12 cases).

The blood supply of an astrocytoma is relatively scanty and is not demonstrated too well by either angiographic or histopathologic methods. Angiograms show stretching and spreading of the larger and medium sized cerebral arteries. Finer arterial branches which are always visible in the normal may be entirely absent. Frequent presence of cysts is one factor to account for sparseness of vessels. The angiogram of diffuse astrocytoma resembles that seen in brain edema.

E. *Other Types of Intracranial Neoplasms.*

The authors' experience with angiography has not been sufficiently large to describe a specific vascular pattern in certain of the rarer intracranial neoplasms.—*John R. Hannan, M.D.*

LINDGREN, E. The technique of direct (percutaneous) cerebral angiography. *Brit. J. Radiol.*, August, 1947, *20*, 326–331.

Three important points in cerebral angiography are the technique of puncture, the opaque material, and the roentgenographic technique. All three are discussed in more or less detail. The puncture is made usually under local anesthesia and an attempt is made to palpate the vessel with the tip of the needle while the needle is in the tissues. The internal, external, or common carotid may be used as needed.

Thorotrast is used in patients who have no voluntary control, but in all others umbradil is used. Thirty-five per cent or 50 per cent solutions are used, depending on the amount of dilution by the blood to be expected, and upon the response of the patient to the weaker solution.

The apparatus used consists of a holder which keeps three films against the side of the patient's head and three underneath while he is supine with the neck in hyperextension. Lysholm grids are used. This apparatus permits anteroposterior and lateral views without moving the patient. Films are made after each of several injections of 8 or 9 cc. of the opaque material in lateral and anteroposterior views.

By this method 153 patients were examined in an eighth month period with 4 technical failures and no serious ill effects. This procedure has been carried out on out-patients.—*E. F. Lang, M.D.*

NECK AND CHEST

NEUHAUSER, EDWARD B. D., and BERENBERG, WILLIAM. Cardio-esophageal relaxation as a cause of vomiting in infants. *Radiology*, May, 1947, *48*, 480–483.

Persistent or recurrent vomiting in the newborn or young infant occurs as a frequent problem in pediatric care. There is a considerable number of patients in whom, because of the repeated and significant nature of the vomiting, roentgenologic examination is warranted. Among this group the authors have observed, in the past three years, 12 patients who exhibited persistent vomiting, evidently due to relaxation or dysfunction of the hiatus portion of the esophagus with failure of the normal "sphincter" action of the cardia. One could postulate that this type of persistent relaxation might be the result of failure of the pinchcock mechanism to function adequately, due to failure of proper development or to imbalance of neuromuscular control.

The patient almost invariably starts vomiting within a week after birth, usually during the first few days of life. The vomiting becomes progressively worse and soon occurs with each feeding. The vomiting may take place during a feeding, especially when air is expelled, but is most apt to occur when the child is put back in his crib in the supine or decubitus position. The diagnosis of cardio-esophageal relaxation depends almost entirely on an adequate fluoroscopic examination of the swallowing function, esophagus and stomach. The barium-filled esophagus usually appears larger than would be considered normal. Some relative narrowing of the hiatus esophagus is observed, but there is persistent failure of the "pinchcock" or "sphincter" action to come into play, so that the esophagus appears as a rather flaccid tube leading to the cardiac end of the stomach. During the inspiratory phase of respiration the esophagus dilates and frequently will fill with barium from the stomach. With expiration the filled esophagus is compressed; some of the barium passes again into the stomach and some is regurgitated into the mouth. When the patient is in the supine position, even slight pressure upon the abdomen will produce retro-

grade filling of the esophagus with air or barium from the stomach. If the patient is observed in the erect position, no regurgitation takes place, although it is usually evident that the hiatus esophagus is open, as frequently one can observe air passing into the esophagus from the stomach.

Treatment of this condition has been empiric. The patients are fed in the sitting or erect position and maintained in this position for thirty minutes after the feeding has been accomplished. In the presence of well defined persistent relaxation, the authors have, in addition, kept the infant propped up and maintained in a semi-sitting position in its crib throughout the day and night. On such a regimen all of the infants stopped vomiting almost immediately and showed good weight gain and normal development.—*Samuel G. Henderson, M.D.*

Kristoff, Frederic V., and Dratz, Henry M. Minor fractures of the cervical laminae simulating ruptured cervical disk; report of two cases. *J. Neurosurg.*, Jan., 1948, *5*, 95–98.

From a differential diagnostic standpoint the lesions described herein are of considerable interest as they at times may simulate the syndrome of a ruptured cervical disc. These factures are minor lesions unless accompanied by cord damage, or occur near the intervertebral foramen. When the intervertebral foramen is involved the fracture is apt to affect the corresponding nerve root on its course through the foramen, thus reproducing the clinical picture of a laterally ruptured disc. Two cases are presented; both were diagnosed clinically as ruptured cervical disc and both patients were successfully operated upon.

The complaints caused by these fractures are identical to those of a ruptured disc, e.g., pain in the neck on motion of the head and radicular pain referable to one root. The objective signs are also identical, e.g., the mechanical signs, present in order to immobilize the fracture, and the neuropathological signs caused by damage of one nerve root. An immediate onset of the above symptoms and signs is the rule when the problem is that of a laminar fracture, whereas the same may have a latent period of variable duration when associated with a ruptured disc.

Roentgenograms of the neck should be taken in stereoscopic views, the anteroposterior, the lateral and oblique exposures, in order to obtain better visualization of detail. However, plain oblique views, taken of both sides for comparison, may be of great aid in directing the surgical approach by showing distinctly either a small bone fragment protruding into the intervertebral foramen in question, or a unilateral disfiguration of same. Myelography is unnecessary if the plain roentgenograms are carefully made. The myelogram may, or may not, show a filling defect in the contrast shadow, giving no lead as to etiology, however.—*K. K. Latteier, M.D.*

Bucy, Paul C., and Ritchey, Hardin. Klippel-Feil's syndrome associated with compression of the spinal cord by an extradural hemangiolipoma. *J. Neurosurg.*, Sept., 1947, *4*, 476–481.

Klippel-Feil's syndrome is a congenital malformation of the neck characterized by a fusion of many of the cervical vertebrae and a reduction in the number of bony components of the cervical spine. There may be an absence of the spinous processes and laminae and also associated neurological abnormalities. When these are present they are usually due to compression of the spinal cord or its roots by bony malformations or a result of malformations of the spinal cord itself. The case reported by the authors is of interest as there was typical clinical evidence of an intraspinal tumor and this was confirmed at operation.

A man, aged thirty-three, had been aware of a deformity of his neck all of his life, but this had caused him little disability. In the course of ten weeks he developed signs of compression of the upper thoracic spinal cord which rapidly progressed to a total paraplegia.

The roentgen examination of the cervical and upper thoracic spine revealed a solid fusion of the 2nd, 3rd, 4th, and 5th cervical vertebrae. The 6th and 7th cervical vertebrae and the first five thoracic vertebrae were fused into a similar long solid mass. The pedicles of the first four thoracic vertebrae were either congenitally absent or had been eroded.

Operation disclosed a friable vascular tumor which compressed the dura mater and the spinal cord. Microscopic examination of the tumor showed a tissue which was basically lipomatous, and scattered through the lipomatous tissue were many vascular channels. The tumor was regarded as a hemangiolipoma.

The authors feel that there can be little doubt but that the extradural hemangiolipoma

which resulted in the compression of the spinal cord in this case and which was responsible for the neurological symptoms was the result of a congenital malformation. Why it did not give rise to evidence of its presence for thirty-three years is as obscure as is its etiology.—*K. K. Latteier, M.D.*

SELDIN, DONALD W., KAPLAN, HENRY S., and BUNTING, HENRY. Rheumatic pneumonia. *Ann. Int. Med.*, April, 1947, *26*, 496–520.

Although the existence of a true pulmonary component of the rheumatic process has been denied, the literature contains enough material to establish the presence of characteristic changes labeled by many as a rheumatic pneumonia. This pathologic process is peculiar to rheumatic activity and is not considered to be the result of such complications as infarction, atelectasis, or intercurrent infection. The precise relationship to rheumatic fever, however, is still obscure. From the various sources in the literature, four hypotheses are offered to explain these pulmonary changes:

1. The lesions are specific manifestations of rheumatic activity in the lungs.
2. The changes are secondary to congestive heart failure.
3. The changes are the result of intercurrent infection.
4. A combination of rheumatic activity and cardiac failure might account for these changes.

In the present series, the authors analyze 6 cases in an effort to bring forth criteria by means of which a clinical and roentgen diagnosis of rheumatic pneumonia might be ventured. In 4 of the cases, serial roentgenograms are reproduced to show the course of the pulmonary process. All of the prominent symptoms and signs are reviewed in detail. Necropsy reports are present on all of the cases. It is emphasized that in all cases the clinical, laboratory, and anatomical evidence of rheumatic carditis was present.

Several photomicrographs of the pathological sections of the involved portion of the lungs are reproduced to illustrate the so-called typical findings. The main points to be noted are: (1) thickening of the alveolar walls and interstitial tissues by cellular infiltrations, proliferation of endothelial cells, and capillary congestion; (2) alveolar exudate which is hemorrhagic in nature; (3) bronchioles lined by a hyaline pseudo-membrane. Typical Aschoff's bodies have been reported by one group.

Clinically, there are two fairly well recognized syndromes. In the first type, the pulmonary symptoms develop insidiously. Toxicity is not great and the temperature is only moderately elevated. Although the respiratory symptoms are minimal, physical signs are striking by comparison. In the second group, however, the pulmonary involvement is rapid and widespread. Dyspnea and cyanosis quickly appear and the case may terminate fatally.

The roentgen changes in the cases presented fell into three fairly well defined categories. These changes were: vascular engorgement, pulmonary congestion and pulmonary edema. The latter finding was the most common. Despite the prominence of the roentgen changes, however, the authors stressed that by this means alone one cannot make the diagnosis of rheumatic pneumonia. Suitable clinical studies are necessary. However, with this combined information, one can usually eliminate the bacterial and primary atypical pneumonic consolidations. The most difficult problem, of course, consists in distinguishing the changes from the various phases of cardiac failure.

In the closing discussion, the authors reiterate that the clinical and roentgenologic criteria for the diagnosis of rheumatic pneumonia are still inconclusive and postmortem verification is necessary. This, of course, makes difficult the evaluation and prognosis in the suspected milder cases. As all the cases in this series terminated fatally, it is fair to assume that the manifestations presented would carry a very grave prognostic significance.—*Robert N. Byrne, M.D.*

GARLAND, L. HENRY. Pulmonary sarcoidosis: the early roentgen findings. *Radiology*, April, 1947, *48*, 333–354.

Sarcoidosis is a generalized disease of unknown origin, in which characteristic histopathologic changes are found in different organs and tissues. It is usually of insidious onset and tends to run a chronic, relapsing course. It is discovered most commonly between the ages of twenty and thirty years.

It is often observed in a phase when involvement of only one system is apparent; for example, lesions of the skin, the eyes, or the lungs. Peripheral lymphadenopathy is present at some stage of the disease in about 90 per cent of the

cases, the nodes being painless, discrete, and movable. Pulmonary involvement (parenchymal or nodal) occurs in a similar percentage of cases. Cutaneous and ocular lesions are seen in about 40 per cent of cases. The usual skin lesions are described as sharply defined, browning nodules (cutaneous or subcutaneous) distributed over the face or extremities. Hepatomegaly and splenomegaly are fairly frequent. Cardiac and pericardial involvement has been noted. As in Hodgkin's disease, *any* tissue or structure can be invaded.

Granulomatous invasion of the bone marrow is fairly common. In a small percentage of cases, multiple radiolucent areas or diffuse lace-like rarefactions appear most commonly in the phalanges of the hands and feet, but may occur in any bones, notably the long bones of the extremities. Hyperglobulinemia, with reversal of the albumin-globulin ratio, is a common finding; eosinophilia is not infrequent. The serum calcium and phosphatase values may be slightly increased.

The tuberculin reaction is usually negative. The diagnosis is made in vivo by the demonstration of a non-caseating or "hard" tubercle in a biopsy specimen, usually from a node or skin nodule. The conditions with which sarcoidosis is most often confused are tuberculosis and Hodgkin's disease.

Gross and microscopic lesions similar to those in sarcoid have been found in some zinc-beryllium-silicate workers (fluorescent lamp manufacturers, etc.).

Chest roentgenographic findings in 36 cases of sarcoidosis are presented, 33 of which were verified by histopathologic examination, and 3 so well established clinically that the diagnosis appears valid.

In the thoracic roentgen film, certain patterns are quite suggestive of pulmonary sarcoidosis. In order of frequency, these are:

(a) Bilateral hilar and right paratracheal adenopathy, with or without associated pulmonary infiltration or nodular densities.

(b) Widely disseminated pulmonary miliary or nodular densities without calcification, in a person clinically well.

(c) Massive enlarged hilar nodes (potato nodes) in an apparently well person.

There is absolutely nothing characteristic in the findings in the individual case. The apparent excellent health of the person in contrast with the extensive roentgen shadows often warrants a surmise of sarcoidosis. The miliary and nodular lesions are due to aggregations of sarcoids in the lung parenchyma. The linear lesions may be due to sarcoid lymphangitis, to lymphedema, to congestion or occasionally to fibrotic changes.

Pulmonary lesions alone, without visible hilar or mediastinal adenopathy, were present at the initial examination in 10 cases.

Pulmonary lesions and lymphadenopathy were present at the initial examination in 13 cases. Six showed diffuse or localized nodular lesions with adenopathy. Seven showed diffuse or localized linear densities with adenopathy.

Lymphadenopathy, hilar, mediastinal, or both, was present as the sole thoracic roentgen finding at the initial examination in 11 cases. Six showed bilateral hilar plus *right* paratracheal adenopathy; 3 showed hilar adenopathy alone; and 1 each paratracheal adenopathy alone, and hilar plus left paratracheal adenopathy.

Pleural effusion was present in only one case.

The intrathoracic lymph node enlargement tends to conform to a curious pattern in which simultaneous enlargement of *both sets of hilar nodes* and only the *right upper mediastinal or paratracheal nodes* occurs. This was found in 7 of the cases with combined parenchymal and nodal lesions, and in 6 of the cases with nodal lesions alone. This has been suggested as "sarcoid-type" adenopathy.

A palpable lymph node or skin nodule is the most desirable tissue for microscopic examination. However, when *none* such is evident, exploration of the mesial end of the right supraclavicular fossa through a short incision will frequently yield *an upper anterior mediastinal node* for study and positive diagnosis.

The miliary type of pulmonary sarcoidosis occurred as an early finding in a minority of the cases.—*Stephen N. Tager, M.D.*

Greening, Roy R., and Menville, Leon J. Roentgen findings in torulosis; report of four cases. *Radiology*, April, 1947, *48*, 381–388.

Greening and Menville discuss torulosis and report 4 cases among 537,135 admissions to Charity Hospital, New Orleans, in a ten year period. There is an excellent summary of the literature and a discussion of the bacteriology and pathology of the disease. Involvement of the central nervous system is predominant and involvement of the lungs relatively rare. Incidence is highest between the ages of thirty and sixty. Meningeal irritation, increased intra-

cranial pressure, and a low grade fever are the chief clinical manifestations. Various neurological symptoms may be present. The presence of enlarged nodes may lead to confusion with Hodgkin's disease. The average spinal cell count is 200 to 500; there is an increase in the albumin and globulin fractions. The organism is best seen in India ink preparations. The authors feel that the bases of the lungs are most often infected. Roentgenograms in the early stage reveal small circumscribed areas of consolidation with only a small amount of reaction about their edges. There is a tendency to confluency and very little evidence of lymphatic drainage. Hilar adenopathy is not a prominent finding. While the pulmonary lesions closely resemble tuberculosis, more frequent involvement of the nervous system suggests a diagnosis of torulosis.

Three of the 4 reported cases died. The one surviving case was treated by chemotherapy, including sulfadiazine, penicillin, potassium iodide, and gentian violet, and also received deep roentgen therapy. No conclusions as to the best method of treatment are presented.

The article provides an excellent summary of torulosis and should be read in full to be appreciated.—*Robert C. Pendergrass, M.D.*

JAMISON, HORACE W., and CARTER, RAY A. The roentgen findings in early coccidioidomycosis. *Radiology*, April, 1947, *48*, 323–332.

Coccidioidomycosis may be acquired by no more exposure than that incidental to passing through an area of endemic infection. These areas include large sections of the arid Southwest, having in common long, hot, dry and dusty summers. A definite correlation has been established between the number and severity of dust storms and the incidence of coccidioidal infections in these regions. The disease is acquired by inhalation of dust contaminated with chlamydospores of the fungus, *Coccidioides immitis*.

An intradermal coccidioidin skin test with a 1/100 concentration of potent extract, if negative, will generally rule out the disease in all but a few of the more severe disseminated infections. The diagnosis is established with certainty by positive precipitin or complement-fixation tests, which are found only in the presence of active infection. Final proof is obtained by culture of sputum or guinea pig inoculation, with demonstration of the causative organism.

Clinically, the conditions most likely to be confused with acute primary coccidioidomycosis are influenza and primary atypical pneumonia. The patient complains of backache, headache, or general aching, or marked weakness, slightly sore throat, loss of appetite, and various indefinite gastrointestinal disturbances. Cough is nearly always present with temperature of a spiking type. Eosinophilia of 3 to 15 per cent is frequently encountered and, when present, is a helpful diagnostic sign. One striking feature in differentiating coccidioidomycosis from the commoner respiratory conditions is the occurrence of chest pain in a high percentage of patients.

One or two weeks later, painful nodules may develop on the shins and elsewhere, characteristic of erythema nodosum. In other cases, macular, papular, or vesicular lesions of erythema multiforme may appear. Skin lesions of these types, when associated with or following an acute respiratory infection, should at once arouse suspicion of coccidioidal infection.

A roentgenogram of the chest taken at the time of onset will show some degree of pulmonary infiltration in about 9 out of 10 cases. Infiltrations vary in extent from the slightest fuzzy thickening of hilar shadows to extensive consolidations occupying a major portion of the lung field. The infiltrations are mostly unilateral, homogeneous, usually hilar or basal in location, and show little tendency to lobar distribution. They vary in density from the lightest veil-like haze to consolidations approaching, but rarely equaling, the opacity of lobar pneumonia. As a rule, they are more uniform, less patchy, more circumscribed than the usual bacterial bronchopneumonias.

The appearance is most likely to suggest the findings encountered in primary atypical pneumonia. It is not often possible, on the basis of roentgenograms alone, to differentiate the two conditions.

Pleural effusion is encountered in approximately one-fifth of all acute primary cases but ordinarily is so small in amount as scarcely to fill the costrophrenic angle; it resolves rapidly and completely as a rule.

Roentgenologically, most coccidioidal cavities are so characteristic that they are seldom confused with other conditions when occurring in endemic areas. A solitary thin-walled ring-like shadow without surrounding infiltration is

typical. Cavities are occasionally encountered with walls so thin and sharply defined as to closely simulate congenital cysts. The differentiation from tuberculosis in the case of apical cavities, and especially those which are occasionally surrounded by coccidioidal pneumonitis, is often not roentgenographically possible. Certain other mycotic infections may produce lesions closely resembling those of coccidioidomycosis, roentgenographically.

Residual "burned-out" nodular or cyst-like foci of coccidioidomycosis are quite characteristic in roentgen appearance and are seldom confused with other conditions when occurring in endemic areas. Among diseases to be differentiated are primary tuberculosis, metastatic carcinoma, congenital cyst, adult tuberculosis, lung abscess, pyogenic and mycotic infections. The discrepancy between the clinical and roentgen findings is often helpful in establishing the diagnosis.

Cases in which mediastinal adenopathy is dominant are usually among the more severe and prolonged of infections and give rise to most of the fatalities. Among the conditions to be considered in the differential diagnosis are Hodgkin's disease, pulmonary tuberculosis, sarcoidosis and bronchiogenic carcinoma.—*Stephen K. Tager, M.D.*

Hollingsworth, R. K. Bronchiogenic carcinoma; an analysis of 343 cases. *Ann. Int. Med.*, March, 1947, *26*, 377–385.

A large factor responsible for the small percentage of operable cases of bronchiogenic carcinoma at the time that definite therapy must be decided upon is the period of delay that occurs between the onset of symptoms and the institution of treatment. This delay period is divided into two phases and an unnecessary prolongation of either may forfeit the patient's chance of cure. The first is between the onset of symptoms and medical consultation and the second is that between the first medical consultation and a positive diagnosis. With this thought in mind, the author reviews a series of 343 cases of pulmonary carcinoma from the various services of the University of Michigan Hospital during the period of January 1, 1938 to January 1, 1944. An attempt is made to bring to light clinical data which will aid in reducing these periods of delay and therefore increase the percentage of operability.

Sufficient data are present in the literature to show that there has been both a relative and absolute increase in the incidence of bronchiogenic carcinoma. The great majority of cases occurs in males between the ages of forty to sixty years. Operability, however, is not affected per se by age. The present series adds nothing to the various theories of etiology, but tends to confirm some of those generally accepted.

The author's conception of the pathology of bronchiogenic carcinoma has changed considerably in the past decade largely due to the availability of resected specimens of earlier lesions. Significant is the fact that the right lung is more frequently involved than the left. The lesions are roughly divided into two groups: those that arise in the hilar areas and those that originate in the lung periphery. Spread is by direct extension and by lymphogenous and hematogenous metastases. The regional nodes are more frequently the site of metastases. Next in frequency is spread to one or both lungs, either directly or by metastases. Other sites of metastases are the pleura, liver, brain, and one or more bones. Metastases and direct spread greatly influence operability.

A histopathological grouping is given which consists of (1) squamous cell, (2) adenocarcinoma (gland cell type), (3) undifferentiated (small cell type, round cell type, and the oat cell type). All are graded from 1 to 4 when possible. The bronchial adenomas classified as carcinoma, grade 1, are excluded from this study. The squamous cell type offered the best prognosis. Adenocarcinoma was found more frequently in women. Bronchial adenomas are likewise more commonly found in women.

Although the author was unable to determine the time lag between the first symptom and medical consultation in his series, he offers Overholt's figure of three or more months. However, in more than 50 per cent of the cases, a diagnosis of bronchiogenic carcinoma was not made for six or more months after the patient sought medical advice. As the initial symptom may be trivial, a low threshold of suspicion is important. The most frequent early symptoms are listed as cough, pneumonia, "flu," cold, chest pain, hemoptysis, dyspnea, and ease of fatigue. Cough in any form is stressed as the most important and initial complaint and the one most frequently explained away for one reason or another. The diagnosis of tuberculosis in the face of repeated negative sputum examinations oft times accounts for loss of much

valuable time. Other easy pitfalls must likewise be guarded against.

Diagnostic measures and points are reviewed in moderate detail. The problem of differentiating tuberculosis, bronchiectasis, and lung abscess is stated. Punch or aspiration biopsy is not recommended. In the presence of suspicious roentgen findings and repeated failure to establish a positive diagnosis, thoracotomy is stressed as a necessity. The hazard of lost time far exceeds the slight operable risk of this procedure.

Surgery is stated as the procedure of choice for treatment, and pneumonectomy is preferred to lobectomy. Roentgen therapy, except for palliation, is condemned.—*Robert N. Byrne, M.D.*

HEUBLEIN, GILBERT W., and GILFILLAN, CLARENCE D. N. A practical technic for visualization of the bronchial tree. *Radiology*, January, 1947, *48*, 37–44.

Bronchography as a diagnostic measure is often indicated when any of the following conditions is suspected: bronchial obstruction, mural growth, pulmonary neoplasm, atelectasis, recurrent bronchopneumonia, a chronic suppurative process. The procedure is definitely contraindicated in the presence of acute inflammatory disease of the tracheobronchial tree. It should be deferred in patients with acute upper respiratory infection and should be used with hesitation in those suffering from asthma.

Postural drainage, mild sedation and omission of atropine are suggested prior to the study. After gaining the patient's confidence by explanation of what is to follow, the pharyngeal region is anesthetized with 2 per cent pontocaine. Using indirect laryngoscopy, the vocal cords are anesthetized and 2 cc. is injected directly into the trachea. A flexible No. 14 catheter is inserted through the nose to a point just above the carina and checked by fluoroscopy in the upright position.

Positions to be assumed to fill the different segments are fully discussed. In general, a thorough appreciation of the anatomy of the bronchial tree in all planes is the basis for positioning for study of each pulmonary segment.

Untoward reactions due to surface anesthesia have been avoided by use of pontocaine. Treatment of severe pontocaine reactions could be remedied by oxygen inhalation and adequate intravenous barbiturates.—*Eugene J. McDonald, M.D.*

LAM, CONRAD R. Pericardial celomic cysts. *Radiology*, March, 1947, *48*, 239–243.

Congenital cysts of the mediastinum may be epidermoid, dermoid, teratoid, bronchial, esophageal, gastroenteric, pericardial celomic and cystic lymphangioma. The last two are purely mesodermal in origin but present striking gross and microscopic differences.

Cystic lymphangiomas are multilocular, cyst walls are of varying thickness, with a relatively complex histological structure. They are intimately attached to adjacent structures from which they derive their blood supply. They are difficult to remove and bleed severely.

Pericardial celomic cysts are simple in structure, unilocular, lined with thin layer of mesothelium. They are easily detached from surrounding parts. They contain clear or sanguineous fluid and are located adjacent to the pericardium. The latter arises from a series of disconnected lacunae which appear early in embryonic life which eventually fuse to form the pericardial celom. If one of these fails to merge it may persist to form a cyst in the vicinity of the pericardium.

Four such cases have been reported in the literature to which the author adds one of his own. A white female, aged thirty-nine, was admitted to the Henry Ford Hospital on March 12, 1944, with a chief complaint of low grade fever of ten years' duration, shortness of breath, fatigue and angina pectoris. For many years she was told she had heart disease, which interfered with her studies and work. In 1935 a chest film revealed unusual cardiac contour with a bulge in the upper left border, which was finally considered evidence of a congenital anomaly.

Periodic examinations showed continued cardiac enlargement which was more pronounced on expiration. Intermittent fever persisted. Anginal symptoms appeared in 1941. The first mitral sound was rough but without a true murmur. The heart became enlarged to the right and posteriorly but without visible pulsations at sites of enlargement. A tumor or cyst was considered the likely diagnosis.

On May 17, 1944, at operation a thin-walled cyst was found anterior to the heart and great vessels, extending to the right and posteriorly. One liter of clear fluid was obtained and then the cyst was easily removed. This was a simple cyst. Postoperative chest film showed normal cardiac contour with absence of the previous

shadow. The patient feels exceptionally well although recurrent fever persists.

The marked change in the contour of the mass between the two phases of respiration may well be a pathognomonic sign of pericardial celomic cyst at this location.—*William H. Shehadi, M.D.*

Sosman, Merrill C. Venous catheterization of the heart. I. Indications, technics, and errors. *Radiology*, May, 1947, *48*, 441–450.

Catheterization of the right heart is most useful in the study of hemodynamics, both in establishing the normals for physiological variations and the changes in the varied forms of heart failure, cardiopulmonary disease and shock. It is valuable also in helping to establish the diagnosis more accurately in congenital heart disease. This latter is especially important now, with the tremendous advances in curative cardiac surgery.

A single lumen catheter, size 9 French, of woven silk and radiopaque, is used. It is 100–125 cm. in length, flexible, and yet stiff enough so that it may be rotated by twisting the exposed end without buckling.

The catheter is threaded into either the right or left median basilic vein, advanced under fluoroscopic guidance and aimed at the desired area by pushing and twisting the proximal end. It is passed upward into the axillary vein to the superior vena cava and into the right auricle. If the tip is turned medially in the right auricle, it may be passed through the tricuspid valve into the right ventricle. From the right ventricle, it may be introduced through the pulmonary valve into the pulmonary artery.

Clotting of blood in the catheter is prevented by a continuous perfusion of normal saline. The comfort of the patient is important for the success of the test. Sedation may be used in nervous or apprehensive individuals.

In the author's series, only 13 out of 100 examinations were unsatisfactory. Venospasm around the catheter in the arm accounted for 2 of these cases. Ventricular extrasystoles occurred in about one-half of the cases when the catheter was passed through the tricuspid valve. This was the only subjective sensation in the great majority of patients. The dangers most commonly feared are damage to the endothelium of the large veins or of the heart, and the possibility of thrombus formation in or on the catheter. Several of the author's patients have succumbed to the disease or conditions not in any way related to the procedure, and in 10 autopsies, no trace of damage could be found in the lining endothelium of the superior vena cava, the right auricle, the right ventricle, the pulmonary arteries, or on the valves.—*Eugene J. McDonald, M.D.*

Dexter, Lewis. Venous catheterization of the heart. II. Results, interpretations, and value. *Radiology*, May, 1947, *48*, 451–462.

To obtain interpretable results in congenital heart disease, venous catheterization must be performed by a well trained team of at least three persons working smoothly and efficiently and should be used in conjunction with the usual procedures of history, physical examination, electrocardiography, fluoroscopy and, if available, the Robb-Steinberg technique of visualization of the cardiac chambers with diodrast. Findings in several representative types of congenital heart disease are described.

In auricular septal defect, blood usually flows from the left auricle to the right auricle. The venous catheter may be introduced through the defect or arterial blood may be found in the right auricle.

In uncomplicated defect in the interventricular septum, there is a shunting of arterial blood from the left ventricle to the right ventricle. Its recognition by venous catheterization depends on the finding of a significantly higher oxygen content of blood in the right ventricle than in the right auricle.

In the tetralogy of Fallot the following may be found: due to the pulmonic stenosis, venous blood enters the pulmonary artery with difficulty, and some is shunted through the septal defect and into the aorta. The venous catheter may follow one of two courses. It may pass through the stenosed pulmonary valve into the pulmonary artery, or it may pass through the interventricular septal defect and go directly into the overriding aorta.

In patent ductus arteriosus, there is a vascular anastomosis between the aorta and pulmonary artery, which during fetal life, serves to bypass the lungs. Its persistence after birth is deleterious, owing to the ease with which bacterial vegetations become implanted and also to the circulatory strain thrown on the left ventricle. The lesion is detectable on venous catheterization by finding arterial blood in the pulmonary artery or blood with a higher oxygen content than in the right ventricle.—*Eugene J. McDonald, M.D.*

HOLT, JOHN F. Epipericardial fat shadows in differential diagnosis. *Radiology*, May, 1947, *48*, 472–479.

It is common knowledge that epipericardial fat pads frequently are visible roentgenographically along the left heart border. However, not so widely recognized are large extra pericardial fat deposits adjacent to the right heart border. On the right side the fat pads are located between the pericardium and the pericardial pleura. Their shape is neither consistent nor entirely characteristic.

In frontal projection it most frequently assumes a triangular configuration, the outer margin of which is somewhat convex. In the lateral view the fat pad is located at the anterior costophrenic sulcus, and its smoothly marginated, bow-shaped, posterior border appears to fuse with the anterior chest wall.

A number of groups of patient case histories and roentgenograms are presented. One group of cases proved to have large right-sided epipericardial fat pads, and one interesting observation in one of these cases was that after a considerable weight loss the mass in the right costophrenic angle decreased in size. The other groups of patients were presented to illustrate the difficulty in differentiating these shadows from significant intrathoracic lesions.

Some of the lesions that produce similar shadows are neurofibrosarcoma, tracheobronchogenic cyst, subpleural tuberculoma, primary tuberculosis, cardiospasm, herniated gastric cardia, aneurysm, atelectasis, and so forth.

The author believes it inadvisable to attempt a roentgenologic diagnosis of a suspected fat pad on the basis of its appearance in a single posteroanterior projection, especially on a miniature film. He feels that a lateral view is very helpful in that significant lesions in the lower right lung field are more apt to be posterior in position, while fat pads are always anterior. He also suggests that complete gastrointestinal studies, bronchograms and bronchoscopy, and the passage of time are necessary means of establishing the differential diagnosis.—*F. B. Markunas, M.D.*

BATT, RICHARD C. A roentgenkymographic study of the heart in myasthenia gravis. *Radiology*, April, 1947, *48*, 374–380.

The roentgen kymograph is recognized as an instrument with ability to record permanently the motion of an organ observed fluoroscopically.

Attention to certain variables which limit the use of the kymograph in studies of this type is recorded. Four normal persons and 16 patients with myasthenia gravis were examined at the Myasthenia Gravis Clinic of the Massachusetts General Hospital.

If the patient had been receiving prostigmine, the drug was withdrawn for twelve or more hours before the examination. During this period symptoms of lassitude, general muscle weakness, ptosis, dysphagia, dysarthria, and other signs of myasthenia gravis usually developed. A roentgen kymogram of the heart was then made. If the initial film was satisfactory, 1.5 to 2.0 mg. of atropine sulfate was given intramuscularly. Fifteen minutes later a second roentgen kymogram was obtained.

Patients with myasthenia gravis frequently showed a slightly increased chest diameter or a slightly lower diaphragm at deep inspiration after a prostigmine injection. This observation was confirmed teleroentgenographically and is consistent with the general picture of myasthenia gravis.

Of the 15 patients with myasthenia gravis, 10 showed a slight decrease in heart rate after the injection of prostigmine. The normal subjects showed a similar decrease after the same medication.

The cases in this series showed no remarkable changes in the waves of the aortic and auricular areas except for slight slowing of the rate. Very definite changes, however, were observed in the ventricular waves. In cardiac roentgen kymograms of patients with myasthenia gravis, spike-like configuration of waves along the ventricular border are noted.

After the prostigmine test dose, the heart rate becomes slower. The spiking of the left ventricular waves disappears. The diastolic limbs are smoother and have changed from concave to convex. Changes of this type were observed in 7 of the 15 cases studied.

It must be concluded that there is no cardiac roentgen kymographic wave form characteristic of this disease.

Limitations of the roentgen kymographic method are particularly noticeable when the auricular and aortic areas are examined. The waves in these areas are extremely variable, deceptive, and frequently difficult to interpret. In the average kymogram these particular waves often do not exceed 1.0 mm. in amplitude, rarely more than 3.0 mm. The superimposed vertebrae and mediastinal structures frequently obscure wave detail. Motion in any portion of

the cardiac border is the result of several directional forces and does not represent the true intrinsic pulsation of one chamber. Auricular waves frequently appear blurred and are often complicated by the distorting effect of transmitted ventricular pulsations. Aortic waves, although more distinct than auricular waves, are determined and influenced by such components as thrusts of blood from the left ventricle, contraction of the aortic wall, aortic tortuosity, and the effects of other stationary and moving mediastinal structures.

The prostigmine test dose produces no characteristic cardiac kymographic wave changes either in myasthenia gravis patients or in normal subjects. The test dose may slow the cardiac rate somewhat, thereby producing deceptive changes in wave contour.—*Stephen N. Tager, M.D.*

Clark, Stanley B., and Koenig, Edward C. Aortic aneurysm secondary to coarctation. *Radiology*, April, 1947, *48*, 392–397.

Clark and Koenig present 2 cases of calcified aortic aneurysm distal to the site of a coarctation. One case, occurring in a twenty-five year old diabetic woman, presented absence of the aortic knob, rib notching and multiple calcified ring-like shadows in the region of the descending aorta. This case was proved at autopsy when marked dilatation of the intercostal arteries was also demonstrated. A second case, not autopsied, showed absence of the aortic knob, multiple rib notchings and a soft tissue density distal to the aortic arch.

The article includes an excellent discussion of the routes by which blood may reach the aorta below a coarctation, namely collateral channels through (1) the scapular and cervical arteries, (2) the internal mammary, (3) the intercostal arteries, and (4) the spinal arteries. The authors conclude that the majority of aneurysms distal to the stenosis are formed directly as a result of the collateral circulation secondary to the coarctation, and are not related to infection.—*Robert C. Pendergrass, M.D.*

O'Loughlin, Bernard J. A study of 24,615 separation chest roentgenograms. *Radiology*, April, 1947, *48*, 389–391.

O'Loughlin reviews 24,615 chest films made upon separation from the Army Air Forces. The incidence of pulmonary tuberculosis was 0.1 per cent in this series of discharge films, compared with an average of 1.0 per cent in induction examinations. The incidence of other abnormalities was practically identical with that found on previous surveys. It was notable that 14 by 17 inch films were included in this survey rather than the smaller types of films. No definite conclusions could be drawn as to whether the 0.1 per cent tuberculosis originated during military service.—*Robert C. Pendergrass, M.D.*

Epstein, Bernard S. Rheumatic mitral valve disease without cardiac enlargement. *Radiology*, March, 1947, *48*, 249–255.

Roentgen studies are frequently sought in the diagnosis of mitral valve disease, demonstrating changes in cardiac size and contour. The accepted teaching is that teleroentgen studies reveal prominence of the second cardiac arc, due to prominence of the pulmonary artery and appearance of the conus arteriosus of the right ventricle on the left cardiac border. In the right anterior oblique position posterior displacement of the barium-filled esophagus indicates left atrial dilation. In the diagnosis of mitral valve disease left atrial dilatation is considered by some as next in importance to the pathognomonic apical diastolic murmur.

Twenty-five cases are reported, 17 females and 8 males, aged ten to sixty-three. Twenty had positive history of rheumatic fever, 2 of chorea, and 3 had no known rheumatic infection. Murmurs in all these cases were diagnostic of mitral valve disease. Blood pressure was within normal limits; the electrocardiogram, with one exception, was negative. Congestive failure occurred in one case during last months of pregnancy. Teleroentgenography and roentgenoscopy, including barium studies of the esophagus, was done. Heart contour and measurements were normal in all cases. The absence of heart failure supports the observation that the heart fails rarely if normal in size.

In the presence of characteristic apical murmur the diagnosis of mitral valve disease should be maintained despite absence of roentgen evidence of enlargement or alteration of cardiac contour.—*William H. Shehadi, M.D.*

Ungerleider, Harry E. Cardiac enlargement. *Radiology*, February, 1947, *48*, 129–142.

This article bears reading and re-reading. It is an extremely important contribution which contains a wealth of information concerning the normal and enlarged heart.

The article is primarily concerned with car-

diac measurements. That measurements are of greater value as an index of generalized enlargement of the heart rather than in determining the size of individual chambers is immediately pointed out by the author.

The author agrees that careful mensuration is unnecessary when gross enlargement of the heart exists. It is the lesser degrees of enlargement, however, that often escape detection unless careful measurements are resorted to. Conversely, apparently large cardiac shadows may assume less significance when considered in relation to standards of body build.

The author prefers to make most of his measurements from the frontal cardiac silhouette. The importance of a meticulous roentgen technique with the patient in the erect or sitting position and with respiration suspended in ordinary inspiration is stressed.

The author has correlated the size of the heart with various factors such as weight, height, surface area, muscular development, thoracic circumference and other thoracic measurements. Body build has a most important determining influence on the size of the heart. The dependence on weight is somewhat greater than on height but the correlation is improved if both weight and height are considered. Apparently, the influence of sex or age in adults on the size of the heart may be disregarded in prediction standards.

According to the author, the simplest and one of the most useful measurements is the transverse diameter which is the sum of the greatest extension of the right border of the heart and of the left border of the heart from the midline. In the author's opinion, the cardiothoracic ratio is crude and inexact.

Because of the increasing employment of teleroentgenograms of the chest for determining cardiac size, the author has developed a new prediction table based upon normal teleroentgenograms of 1,460 normal subjects. The actual transverse diameter of the heart should not be interpreted too strictly because of appreciable physiological variations in the size of the cardiac silhouette attributable to different phases of the cardiac cycle and to respiration. However, diameters more than 10 per cent above the predicted value may be regarded as abnormal and the heart may be considered as almost certainly enlarged if the transverse diameter is 15 per cent in excess of the predicted dimensions. The author discusses two other diameters, the long and broad diameters, which he considers somewhat less valuable than the transverse diameter. The long diameter extends from the junction of the cardiac and vascular silhouette on the upper part of the right border of the heart obliquely downward to the apex on the left. This diameter which is approximately 10 per cent greater than the transverse diameter is increased chiefly as the result of left ventricular enlargement. The broad diameter is the greatest diameter perpendicular to the long diameter. Whereas the broad diameter is often drawn as the sum of the two perpendiculars from the long diameter to the lower right and upper left heart borders, it more properly should be considered the greatest single diameter from upper left to lower right heart border perpendicular to the long diameter. The long and broad diameters are of interest not so much by themselves but for their product which represents the frontal cardiac area. Based upon these studies the author recently prepared a nomogram for prediction of the cardiac area from weight and height and actual area as calculated from the long and broad diameters.

It is the author's opinion that the use of either or both the transverse diameter and the nomographic determination of frontal area presents two simple and accurate methods which should suffice to determine whether cardiac enlargement is present.

The author also found that the transverse aortic diameter in normal subjects is closely related to weight and height. Based upon these studies a table was established for predicting the transverse diameter of the heart from weight and height which seems very reliable. It is noteworthy that the right border of the vascular pedicle is formed on the superior vena cava in the majority of young subjects whereas in later life it is more frequently formed by the right border of the ascending aorta.

The author suggests that interpretation of heart size should not be confined to measurements alone. He urges that, as far as possible, enlargement should be described in terms of the chambers involved since characteristic changes occur in various types of heart disease.

This article contains a complete table of theoretical transverse diameters of the heart for various heights and weights.—*Philip J. Hodes, M.D.*

ABDOMEN

GERSHON-COHEN, JACOB. A duodenal mechanism regulating the motor and secretory activity of the stomach; its roentgenographic disturbance in duodenal ulcer. *Radiology*, March, 1947, *48*, 232–238.

The duodenum contains a mechanism influencing tone, peristalsis, pyloric action and gastric secretion. In duodenal ulcer this mechanism is disturbed resulting in abnormal motor and secretory function.

Normally a 250 cc. barium-water meal leaves the stomach in about sixty minutes. Adding 0.25 per cent HCl to the meal delays gastric emptying. When 0.25 per cent HCl solution is dripped into the duodenum emptying is still more delayed, while isotonic alkaline solutions have no effect. Stronger acid and alkaline solutions, hypertonic solutions of electrolytes or non-electrolytes cause marked delay. Fats and fatty acids are most powerful stimulants of the duodenal mechanism, hence their importance in ulcer therapy. With stimulation of the duodenal mechanism gastric peristalsis abates, the pylorus contracts and emptying is delayed or stopped. The duodenal bulb is most sensitive to such stimulation. In duodenal ulcers, which occur mostly in the bulb, normal stimuli are inadequate to stimulate the inflamed mucosa, hence disturbed motor function and rapid emptying.

In healing of a duodenal ulcer normal sensitivity is recovered by the duodenum with disappearance of gastric motor and secretory disturbances. Persistence of the latter after disappearance of the ulcer crater and symptoms should make the roentgenologist cautious in evaluating healing.—*William H. Shehadi, M.D.*

OULD, CARLTON L., and DAILEY, MORRIS E. Simultaneous radiographic and gastroscopic examination of the stomach. *Radiology*, January, 1947, *48*, 8–14.

In an attempt to clarify differences in the roentgenographic and gastroscopic appearance of the stomach, the authors made simultaneous roentgenographic and gastroscopic examinations of the stomach in 4 patients. In order to visualize the mucosa, a medium had to be found which would give satisfactory contrast on the films, yet be relatively transparent at gastroscopy. The high cost of a very excellent medium (pantopaque) prevented its routine use. The medium finally selected by the writers for their studies was composed of equal parts of diodrast and a saturated aqueous solution of methyl cellulose.

Using the stomach of a fresh cadaver, distended and inflated without distortion on rubber strips between parallel metal bars, it was found on gastroscopic examinations that the fundus, the lesser curvature between the angularis and pylorus, as well as a strip of the posterior wall were in blind areas. Immediately after emptying the stomach, 60 cc. of the methyl cellulose-diodrast mixture was instilled and the gastroscope was promptly inserted while the patient was lying on his left side on the roentgenographic table. By this method a sharp round image of the mucosa was obtained, and vision was clear at any angulation as long as the flexible portion of the gastroscope deviated no more than 30° from the long axis. Roentgenograms were taken in the left lateral and anteroposterior projections, recording the position of the gastroscope at the moment the gastroscopist visualized important landmarks in the stomach. As much as 2,000 cc. of air may be introduced into the stomach during the course of a routine gastroscopy. Films demonstrated that there was a considerable amount of air distending not only the stomach but the duodenum and upper small intestine as well. This surprising amount of air in the small intestine, increasing in volume as the examination progresses, pushes the stomach anteriorly and may in some instances distort its lower pole considerably. Even with the little weight of the medium used the stomach was seen to pass well across the spine to the left or lowermost side of the body. This extensive mobility may well be significantly reduced in cases where perigastric inflammatory or neoplastic infiltration and adhesions have fixed the stomach. Roentgenologic studies might prove this to be a differential point of importance, for it is known, for instance that when the pylorus is seen abnormally far posteriorly on gastroscopy, the presence of a penetrating duodenal ulcer is suggested. This method would have real clinical value if, thereby, radiologists could inform surgeons that a pathologic process had extended beyond the stomach.

This study suggests that the zones visualizable at gastroscopy could be increased by a slight change in the instrument. If the source of light were not separated from the objective,

the angulation and the cone of light would more nicely coincide. This would make it possible to see more of the posterior wall.—*Samuel G. Henderson, M.D.*

ZANCA, PETER. Gastrocolic fistula complicating carcinoma of the colon; a case report. *Radiology*, March, 1947, *48*, 244–248.

Gastrocolic fistula, a long established entity, is rare. It occurs as a complication of other gastrointestinal or intra-abdominal lesions. The clinical diagnosis can be made in the presence of fecal vomiting without intestinal obstruction. Other symptoms are fecal odor to the breath, general weakness, extreme weight loss, persistent diarrhea with undigested food in stools. Signs and symptoms may vary with different lesions. Roentgen studies readily establish the diagnosis.

A thirty-seven year old male was admitted to the hospital because of rectal bleeding, abdominal pain, diarrhea, general weakness and a left upper abdominal mass. Patient consumed a pint of whisky daily. He was discharged from the Army because of varicose veins. Symptomatic treatment seemed to relieve several attacks of cramps and abdominal pain seven months prior to admission.

Laboratory studies revealed marked anemia, negative Kahn reaction and urinalysis. Gastric total acidity 130 and free HCl 110 (after histamine). Stool, occult blood three plus.

Roentgen studies: Chest negative. Esophagus normal. Barium demonstrated an irregular filling defect of the greater curvature, and passed immediately into the descending colon. Barium enema demonstrated a filling defect in the region of splenic colon then entered the stomach through a fistulous tract, which was best visualized after air injection. A palpable mass was present at this level.

The tumor was resected and a gastroenterostomy and an end-to-end anastomosis of the colon performed. The tumor was a primary carcinoma of the distal transverse and splenic colon, with involvement of the greater curvature of the stomach. The fistulous tract was lined with tumor tissue.

Microscopic diagnosis was adenocarcinoma of the colon.

Following a mildly stormy course the patient made an excellent recovery, has gained weight, is up and around and active two months after operation.—*William H. Shehadi, M.D.*

EUPHRAT, EDWIN J. Roentgen features of mucocele of the appendix. *Radiology*, February, 1947, *48*, 113–117.

The author reports his findings in a patient with mucocele of the appendix in which the correct preoperative diagnosis was made on the basis of criteria previously reported by Åkerlund.

According to Åkerlund, fairly definite roentgen criteria for this diagnosis have been established. Usually a sharply circumscribed globular or reniform soft tissue mass with considerable mobility firmly attached to the cecum is found. As a rule, the cecum is displaced medially by this mass. Finally, the presence of *calcium deposits* in the wall or substance of the mass, particularly when the appendix has not been visualized, is of particular significance.

Reviewing the literature, the author found that mucoceles of the appendix occur approximately once in every 300 operated upon. It is generally accepted that the primary etiologic factor is obstruction of the lumen of the appendix in the absence of pyogenic infection. The lesion is usually benign. When the cyst contains an adenocarcinoma which ruptures into the peritoneal cavity, pseudomyxoma peritonei may result. Usually the lesion varies in size from a small localized enlargement of the appendix to a globular mass which may be more than 10 cm. in diameter.

This article contains excellent photographs of a mucocele of the appendix which had been removed surgically, with reproductions of the original barium enema films which clearly visualize the defect produced by the small tumor mass in the right lower abdominal quadrant.—*Philip J. Hodes, M.D.*

BREWER, ARTHUR A. Cholecystography: a comparative study of oral and intravenous contrast substances. *Radiology*, March, 1947, *48*, 269–273.

Of 150 patients examined with priodax, 104 showed normal gallbladder shadows; the other 46 cases were studied by intravenous sodium tetraiodophenolphthalein in addition to priodax.

The results were similar in 39 of the two examination studies and dissimilar in 7 of the cases. The disagreement arose when the priodax examined cases yielded faint shadows and on intravenous examination were found to have

normal concentration. Some of these patients later showed normal priodax concentration.

The author feels that the faint priodax shadow may be due to organic pathology or to physiological stasis of bile which may be eliminated by adoption of a routine high fat diet immediately prior to priodax cholecystography.—*Samuel H. Fisher, M.D.*

Rigler, Leo G., and Mixer, Harry W. Cholangiography and biliary regurgitation. *Radiology*, May, 1947, *48*, 463–471.

Opaque oil was discontinued because of viscosity and its tendency to form globules which result in uneven distribution. Thorium dioxide sol was used until some leaked into the peritoneal space and caused a violent peritonitis. Now diodrast is used. With this solution a partial or complete obstruction to the common ducts sometimes gives a visualization of the kidney pelves. However, at other times the kidney pelves do not show even though obstruction of the common duct exists. This is explained as due to lack of sufficient pressure upon the opaque material to cause a regurgitation from the biliary radicles into the blood stream. The visualization of the kidney pelves was observed in 8 cases out of 460 cholangiographic studies.

The cause of systemic reaction following the procedure is discussed. The opinion is advanced that such reactions are due to transient bacteriemia rather than to distention of the bile ducts. Therefore, care should be exercised to keep the injection pressure low enough to avoid forcing bacteria or other foreign material into the blood stream.—*J. H. Harris, M.D.*

GYNECOLOGY AND OBSTETRICS

Scarpellino, Louis A. Cephalopelvimetry. *Radiology*, January, 1947, *48*, 45–49.

One of the factors contributing to the difficulty of labor is the size and weight of the fetus. Unquestionably, weight and size are to be considered, but if the head of an apparently normal fetus can be delivered, the act of parturition can be consummated. From a clinical-obstetrical, as well as a roentgenmensuration standpoint, cephalopelvimetry resolves itself into two main procedures: determination of the capacity of the maternal pelvis, and determination of the size of the head that must be delivered.

The method proposed by Ball and Marchbanks in which the linear measurements of a maternal pelvis and the circumference of the fetal skull can be expressed in terms of volume, represents a decided advance. In most methods of cephalometry, attempts are made to measure the lineal diameter of the fetal skull, but there is no assurance that the particular linear diameter measured represents the dimension that is to be delivered. Also because of rotation and position of the fetal head, this linear measurement is difficult to attain accurately, and is unquestionably subject to considerable error. If the circumferences of a spheroid are taken at right angles, the volume determined from their mean average will approach the volumn of a sphere having the same perimeter measurements. Practically, therefore, the fetal head may be considered a sphere.

According to Ball's technique, the symphysis pubis is the fixed point from which all measurements in the mid-sagittal plane of the body are made. In the author's experience, when the symphysis and sacrum do not coincide, the error relative to the fetal head volume is considerable. To reduce the error of magnification, the difference between the ventral and dorsal mid-sagittal planes is bisected to arrive at the object-film distance for the lateral circumference of the fetal head. In the case of breech presentation the posteroanterior standing projection is used, together with a right or left lateral projection, depending on the position of the fetal head relative to the mother. By this technique, the fetal head is closer to the film, easier to delineate, and subject to less distortion. The difficulty and duration of labor increase as the disproportion between the fetal head and the smallest plane of the pelvis approaches 200 cc. in the anterior, and 135 cc. in the posterior rotation. The author has studied 500 cases at various intervals during pregnancy, and obtained the head measurements. His figures show an average error of ± 10 cc. in volume or ± 2 mm. in circumference. A corrected growth curve is presented, showing the absolute volume of the fetal head in utero, on the basis of this series.—*Eugene J. McDonald, M.D.*

GENITOURINARY SYSTEM

Myers, Leonard A. The range of usefulness of intravenous pyelography. *Radiology*, January, 1947, *48*, 63–65.

In patients suspected of sensitivity, the author gives a trial injection of 3.0 to 5.0 cc.

intravenously and completes the injection after a five minute interval. Over 1,500 examinations were made in ten years, and all injections of the dye were completed. No deaths were attributable to the procedure.

Concentration of the urine by dehydration of the patient has been found more effective than the use of large amounts of dye.

In children, the period of maximum concentration is at the five minute interval. In adults up to fifty years of age, maximum concentration is found at about fifteen minutes, while in the aged, it is usually later.

Pathological alterations in clearance are of three types: (1) acute mechanical suppression, when the renal parenchyma shows considerably more concentration than does the unobstructed kidney. There is no associated cortical thinning of the affected side, nor any compensatory hypertrophy of the unaffected kidney; (2) chronic mechanical obstruction may show that the functional thrust of the affected kidney is delayed for one or more hours, and there will be more or less cortical thinning associated with varying degrees of pelvic dilatation. There will also be found compensatory hypertrophy of the cortex of the opposite kidney as well as compensatory function; (3) in nephritic involvement without mechanical obstructive uropathy there is poor concentration on both sides throughout a long period of clearance without ureteral pelvic distention.

Bilateral ureteral compression is made over the sacroiliac areas at the period of maximum thrust, which is usually at the fifteen minute interval. Compression is maintained for five minutes at the end of which time the proximal half of each ureter and the pelvis and calyces of each kidney are filled to distention if no organic lesion is present. Lack of distensibility suggests pyelonephritis. Ureteral kinks and unusual excursion of the kidneys not producing a disturbance in drainage, are not considered pathological.—*Eugene J. McDonald, M.D.*

NERVOUS SYSTEM

SCOVILLE, WILLIAM B., MORETZ, WILLIAM H., and HANKINS, WALTER D. Discrepancies in myelography; statistical survey of 200 operative cases undergoing pantopaque myelography. *Surg., Gynec. & Obst.*, May, 1948, *86*, 559–564.

Many articles have extolled the virtues of pantopaque and other contrast myelography in the study of the ruptured intervertebral disk. The authors attempt to point out certain limitations of this diagnostic method. They have surveyed 200 operative cases from Cushing General Hospital in 1944–1945. The survey was undertaken when the neurosurgical author and several independent roentgenologists commented on the difficulty in making a clear cut diagnosis of the presence or absence of a ruptured disc by myelography alone.

From a detailed analysis of these 200 cases it appears that the largest percentage of error occurs in those myelograms incorrectly diagnosed as normal. In fact, if operation is performed upon all cases having clinical evidence of a disc but a "normal" myelogram, an error in myelography will be found in 74 per cent of those cases. Twenty-four of 25 cases in this 74 per cent will reveal a laterally placed lumbosacral disc at operation. The second largest percentage of error occurs in the false localization of single discs. These two groups together cause 50 per cent of all myelographic errors. In contradistinction, technical errors are few and "positive" myelograms will be correct in 95 per cent of the cases. With these facts in mind the authors will continue to use pantopaque myelography routinely on all ruptured disc suspects but will tend to discount all "normal" myelograms if contradicted by the clinical findings.

Conclusions

1. Clinical evidence of a ruptured disc is more important than is myelographic evidence.

2. A positive myelogram is more important than a negative myelogram. A negative or normal myelogram in the face of clinical evidence of a ruptured disc will be wrong three out of four times.

3. Myelography fails to rule out the presence of a laterally placed lumbosacral "disc." In 24 of 25 cases of ruptured disc in which the myelograms are normal, the location is in the lateral lumbosacral interspace.

4. Root sheath asymmetry is an important yet equivocal myelographic sign which may or may not indicate the presence of a ruptured disc; it is of little value without confirmatory clinical evidence.

5. Myelographic double defects are more common than are actual double "disc" ruptures or herniations.

6. When myelography is used as the sole diagnostic criterion, the over-all error is in the neighborhood of 25 to 35 per cent in contrast

to the 6 to 8 per cent cited in the literature.—*Mary Frances Vastine, M.D.*

Denny-Brown, D. Primary sensory neuropathy with muscular changes associated with carcinoma. *J. Neurol., Neurosurg. & Psychiat.*, May, 1948, *11*, 73–87.

Two cases of primary simple degeneration of dorsal root ganglion cells associated with primary degeneration of muscle ("polymyositis") are described. Both cases presented a spreading numbness and sensory loss of the extremities and one of the face, without pain, but with severe and progressive ataxia. In both instances, bronchogenic carcinoma was present. Presence of a metabolic disorder related to the tumor cells is presumed, for the neuromuscular condition reproduced changes that have been seen in pantothenic acid and vitamin E deficiency in animals.—*Russell R. Jauernig, M.D.*

SKELETAL SYSTEM

Gilmore, John H., and Mahan, Thomas K. A case of acromegaly presenting specific roentgenographic changes. *Radiology*, January, 1947, *48*, 50–53.

Overgrowth of the lateral and anterior aspects of the bodies and intervertebral discs, resulting in a thickening of the spinal column, are described as specific changes in acromegaly. Erdheim is quoted as stating that he was able to distinguish between the original vertebral bodies which presented a biconcave configuration, and the additional bone proliferation which extended directly from their anterior and lateral aspects. Similar proliferation of the cartilage of the intervertebral discs was observed. Other authors are quoted who showed the autopsy findings of an acromegalic where pronounced fusiform widening of the ribs, and irregular ossification of the costochondral junctions were observed.

A case report of a white male, aged thirty-one, is presented, with costochondral and vertebral changes present as shown by roentgenograms.—*Eugene J. McDonald, M.D.*

Galluccio, Anthony C. Observations on gunshot fractures of the mandible. *Radiology*, March, 1947, *48*, 260–265.

More than 200 mandible fractures due to direct force (gunshot wounds in soldiers) are considered. Routine roentgenography consisted of right and left lateral oblique films and posteroanterior films all in stereo. Intraoral films were used as an adjunct.

Osteomyelitis was not a common complication; non-union was demonstrated by the usual methods. It was noted that clinical union preceded roentgenographic union by many months.

Most fractures seen were comminuted, located mostly in the anterior body and symphyseal regions. Twenty-two per cent of the cases had extensive bone loss, 25 per cent showed metallic foreign bodies and 38 per cent of the cases had associated facial bone injuries.—*Samuel H. Fisher, M.D.*

Cooper, George, Jr., Adair, Norman, and Patterson, William M. Familial osseous atrophy. *Radiology*, May, 1947, *48*, 509–513.

One case of familial osseous atrophy, a disease of unknown etiology, is reported in a white male, aged twenty-five. The patient's complaint began with pain in the feet on long periods of standing, especially at the first and second metatarsal heads where thick callus appeared. When the callus had been present several months it blistered and sloughed, leaving large ulcers. The ulcers recurred with sloughing of small pieces of bone until the distal ends of the feet were lost.

The roentgen findings are atrophy and necrosis of bone with multiple amorphous sequestra. No periosteal reaction. The cortex was moderately decreased in density and the surface slightly irregular. The authors demonstrate their findings in roentgenograms and state that they are characteristic of the disease.

In the family history it was found that the patient's paternal grandfather, father and two uncles suffered from the same condition until their feet were practically gone.

The disease is progressive after onset and terminates in crippling of the patient, but no deaths have been known to occur from this malady.—*F. B. Markunas. M.D.*

Russo, Peter E. Malignant melanoma in infancy. *Radiology*, January, 1947, *48*, 15–19.

Malignant tumors most frequently seen during the first five years of life are retinoblastomas, renal tumors (Wilms'), and neuroblastomas of the adrenals or sympathetic nervous system, usually in the order mentioned. Melanomas occur very infrequently but they may be present at birth or they make their appearance at any time during life. Many are first noticed

shortly after puberty. It is doubtful that a nevus first recognized later in life is of recent origin; it is probably due rather to growth of a previously quiescent lesion. Only a small percentage of melanomas ever become malignant.

In children the predisposing factor of trauma or irritation is insignificant, and hormonal stimulation has been suggested by some authorities as playing an etiologic role.

Three cases are reported by the author—1 being congenital and 2 occurring at the age of three years. In the child with a congenital lesion evidence of wide spread metastases was present at birth. Roentgenographic examination revealed destructive bone lesions involving the lateral aspects of the distal metaphyses of both femurs, with little evidence of bone reaction. In their symmetrical distribution and location, the lesions were not unlike those seen in congenital syphilis of bone. In an Indian girl aged three years a malignant growth was not suspected until microscopic examination of the tissues was done. In spite of early excision of the primary lesion only six weeks after the period of onset metastases had already taken place. Films of the skeleton revealed destructive lesions involving the 5th lumbar vertebra and the left sacroiliac joint, the sacrum, both iliac bones, the upper ends of the femurs, and the 9th dorsal vertebra.

In the third case, a three year old colored girl, a small nodule first became noticeable about one year before medical consultation. It was located on the lateral aspect of the left knee. The lesion was widely excised. A lymph node in the left inguinal region was noted soon after. Because of inability to determine definitely whether the enlarged inguinal node was of an inflammatory or malignant nature, a very moderate amount of deep roentgen therapy was given—1,200 r, in air (170 kv., 20 ma., 50 cm. distance, Thoraeus filter). The child was not seen again until three months later. The lymph node in the inguinal area had enlarged to twice its previous size. The involved lymph node was removed and ligation and section of the left saphenous vein was performed. Microscopic examination of the tissue showed invasion replacement with tumor cells resembling those occurring in the original lesion. Additional deep roentgen therapy over the left inguinal area was given, similar in amount to the previous series. This patient has been closely followed for over three years without any evidence of recurrence or metastasis.—*Samuel G. Henderson, M.D.*

ROENTGEN AND RADIUM THERAPY

McINDOE, A. H., FORBES, ROBERT, and WINDEYER, B. W. Symposium: radiation necrosis. *Brit. J. Radiol.*, July, 1947, *20*, 269–278.

A. H. McIndoe: Few radiologists know how common radiation necrosis is, because the patient often does not return to the radiologist after the development of this condition, and because the serious effects do not develop until much later. Ultimately they all see plastic surgeons. The great majority of these patients have been treated for benign conditions.

After repeated doses of roentgen radiation, and after the acute inflammation has subsided, pigmentation, telangiectasis, and progressive atrophy follow. Because of markedly reduced healing power eventual trauma followed by infection produces an ulcer which heals with difficulty. Malignancy develops in one-fifth of the cases.

The lesions which previously led most frequently to ulceration after roentgen-ray overtreatment are lupus, tuberculosis, exophthalmic goiter, superfluous hair, and psoriasis. These were usually in non-functional areas of skin, and plastic repair was accomplished fairly easily.

Most recently, the lesions, the treatment of which leads most frequently to ulceration, are plantar and palmar warts and pruritus ani and vulvae. Ulceration in these sites exposes important structures and repair is not so easy. In the hand, permanent crippling follows unless an efficient covering is rapidly supplied. In the foot, grafts are usually not successful and do not sustain weight-bearing well. In the perineum it may be necessary to do a colostomy or even a vulvectomy, and reconstruction is difficult.

McIndoe proposes that benign lesions of the palms, soles or perineum be treated by means other than roentgen radiation.

Robert Forbes: Fundamentally, roentgen treatment is the use of roentgen rays to produce partial or complete death of certain tissues that are superficial or deep. A justifiable degree of therapeutic necrosis is sometimes difficult to distinguish from an unjustifiable degree of radiation necrosis. In an

attempt to delineate the boundary between these two, it must be remembered that there is a patient-physician contract. The patient is obligated to pay for the treatment and the physician is obligated to furnish a requisite degree of care and skill such as might reasonably be expected from an individual of his qualifications and experience. If the physician uses this care and skill with the consent of the patient for the treatment it is quite unlikely that a court of law would find the physician negligent if a patient sustained damage by the treatment. On the other hand, radiation necrosis is an obvious condition which speaks for itself, and in defending himself against an allegation of negligence the radiologist must consider the safety of the dosage, the sensitivity of the patient, the adequate shielding of adjacent structures, and the follow-up of the patient. The radiologist is legally liable for the provision of safe equipment.

When a radiologist is confronted with an awkward situation relating to radiation necrosis it is wise for him not to attempt to handle the matter himself, but he should give it immediately to his medical defense organization.

B. W. Windeyer: Acute necrosis develops immediately after treatment. The erythema is followed by a fibrinous membrane on the mucosa or on skin by dry and then moist desquamation. Edema rapidly follows, the lesion is painful, and a slough of variable depth occurs. Endarteritis and fibrosis prevent healing for months or years. This type is caused by (1) overdosage of normal tissue, (2) overtreatment of sensitive areas, as the perineum, sole, palm, or a scar, (3) treatment of previously irradiated areas or (4) treatment in the face of acute bacterial invasion. It may even result from over enthusiastic nonradiotherapeutic treatment of a normal roentgen irradiation reaction.

Late necrosis occurs months or years after treatment which has caused fibrosis and local anemia. It may be obvious damage as in skin, or hidden damage, as in the bone and cartilage. The treatment may have been single and massive or multiple in suberythema doses. Ulceration is preceded by fibrosis and telangiectasis which lower resistance to physical and bacterial trauma and these, combined with poor blood supply, permit eventual ulceration. Late necrosis is sometimes easily confused with malignant ulceration in a recurrent lesion, and the two may coexist. Late necrosis of bone and cartilage deserve special mention because of the prolonged course and insidious development. Underlying cartilage and bone in the mouth, throat, chest, hand, foot, and scalp are particularly susceptible because of the frequency of trauma in these regions.

In another fashion necrosis may be divided into four types. First, it may be an inevitable risk in a perfectly justifiable attempt to cure cancer. Second, it may be unjustified as in faulty technique, ignorance of the effects of roentgen rays, and treatment of a necrotic ulcer mistaken for a recurrence. Third, it occurs in patients who are being treated palliatively. Since, in some, the best palliation is achieved by giving a curative dose, in some cases the ulceration is justified. Fourth, the majority of cases of necrosis occur in the treatment of nonmalignant conditions. Where it develops the dose was unjustifiably large, or an unsafe dose was given to a sensitive region, or repeated doses were mistakenly given.

Radiotherapy is usually safe in ringworm of the scalp, sycosis barbae, thyrotoxicosis and keloids. It should not be used in hypertrichosis, hyperidrosis, or pruritus ani. A carefully selected group of plantar and palmar warts might possibly be safely treated with a single dose of roentgen rays.

In the field of treatment of malignancy the development of some ulceration is inevitable and a therapist who has never seen a case develop after his treatment has been guilty of the greater crime of consistent inadequate dosage. —*E. F. Lang, M.D.*

Cross, James E., Guralnick, Eugene, and Daland, Ernest M. Carcinoma of the lip—a review of 563 case records of carcinoma of the lip at the Pondville Hospital. *Surg., Gynec. & Obst.*, Aug., 1948, *87*, 153–162.

Carcinoma of the lip, one of the most malignant neoplasms of the oral cavity, is one of the most readily curable malignancies encountered in the body. Because of the prominent location it is usually brought to the attention of the patient at an early stage and, therefore, should be seen by the physician while still amenable to treatment. This study was undertaken in an effort to evaluate the results of treatment of all patients with carcinoma of the lip either seen in the Out-Patient Clinic or admitted to the Pondville Hospital from the time of its establishment in June, 1927, to December, 1941.

This particular time period was chosen in order to have a complete five year follow-up record on all the patients who received treatment.

Conclusions

1. Carcinoma of the lip is the most readily curable malignant tumor of the oral cavity and treatment of 407 unselected cases at the Pondville Hospital resulted in 67.1 per cent three year cures. Of the patients who received all their treatment at Pondville 81.4 per cent achieved three year cure status.

2. Surgery is the preferred method of treatment at this hospital.

3. Three year cures are as significant statistically as five year cures in carcinoma of the lip.

4. Carcinomas of the labial commissures are approximately twice as difficult to control as lesions in other locations on the lips.

5. Curability of carcinoma of the lip is directly related to the size and pathological grade of the primary tumor and the presence (or absence) of lymph node metastases.

6. It was found that 35.9 per cent of the patients who underwent neck dissection, with pathologically proved cervical lymph node metastases, attained the three year cure stage. —*Mary Frances Vastine, M.D.*

RICHARDSON, W., and ROBBINS, L. L. The treatment of polycythemia vera by spray irradiation. *New England J. Med.*, Jan., 1948, *238*, 78–82.

Control of polycythemia vera by long bone irradiation was first reported by Lüdin in 1916, and in 1932 Sgalitzer described the results from total body irradiation. At the Massachusetts General Hospital, spray irradiation covering a field from neck to knees has proved the most successful of any procedure tried, although the authors point out that comparative results of radioactive isotope therapy were not studied.

Twenty-eight cases were treated, using anterior and posterior fields on alternate days. Factors of 200 kv., 0.5 mm. copper and 1.0 mm. aluminum filtration (half-value layer 0.92 mm. copper), were found satisfactory. The daily dose was 20 to 30 r, measured in air, and the total dose approximately 300 to 500 r in any one series, divided between anterior and posterior fields. Selection of a small daily dose seemed to prevent severe roentgen sickness, and prolonged remissions were obtained. The amount of treatment is determined by following the total white blood cell count. Treatment is stopped when the white count falls below 5,000. Red blood cell and hemoglobin levels are not considered, as there is apt to be little change in these values for one or two months.

Twelve patients died, the deaths in 4 apparently unrelated to the polycythemia or its treatment.

Thirteen of the 16 living patients have no symptoms attributable to polycythemia. One has persistent hypertension, a second has a refractory anemia possibly due to the irradiation, and a third has numerous symptoms and an increased red blood cell count although still alive after seven years. Tabulation of the duration of remission produced by single courses of from 200 to 1200 r suggest that a total dosage of 400 to 500 r may be expected to produce a remission of six months to five years.

Treatment of polycythemia vera by phlebotomy is condemned as unsound because of its stimulating effect on bone marrow activity, its production of "plethoric anemia," and its apparent propensity to result in leukemoid states. The use of phenylhydrazine has been discarded because of difficulty in regulating dosage.

Although effective and safe when properly used, spray therapy is dangerous if employed injudiciously. It is specifically contraindicated in elevated red blood cell count due to anoxia, in the occasional high red cell count of extramedullary hematopoiesis ("myeloid metaplasia"), and in the benign familial hypochromic polycythemia often seen in members of the Italian race.—*Henry P. Brean, M.D.*

POHLE, ERNST A., and TOMLINSON, CAROL. Roentgen therapy in traumatic myositis ossificans. *Am. J. M. Sc.*, April, 1948, *215*, 372–380.

Ten cases of symptomatic myositis ossificans traumatica are presented which were treated with roentgen rays.

Technical factors: 175 or 400 kv., 50 cm. focus skin distance, half-value layers of 1.05 mm. Cu and 2.4 mm. Cu respectively. Field size was large enough to include a wide zone about the area of calcification; doses of 150–200 r (air) are delivered to one to two fields daily or every other day for three or four treatments. When indicated, a second series is given in four to six weeks and a third in two to four months after the first series. In 5 cases, only one course was necessary.

Complete relief of pain was observed in all

cases. Limitation of motion was markedly improved or restored to normal in all but one, in which only slight improvement in function was made.—*Russell R. Jauernig, M.D.*

DEL REGATO, J. A. The role of transvaginal roentgen therapy in the treatment of carcinoma of the cervix. *Surg., Gynec. & Obst.*, April, 1948, *86*, 480–486.

In the majority of cases of carcinoma of the cervix, a thorough external irradiation is the most important single factor leading to permanent control. But the external irradiation is seldom sufficient to sterilize the tumor. The diminution of secondary infection and inflammation and the diminished dimensions of the tumor area, resulting from the external pelvic irradiation, make it possible for the internal phase of the treatment to achieve the destruction of the remnant of the tumor. The internal treatment compensates for the insufficient total dose and rather weak daily dose received by the remaining carcinomatous cells. A skillful application of radium in the uterus and in the vagina succeeds in controlling the residual tumor in an appreciable number of cases. The author has no quarrel with this classic form of treatment that could yet yield better results. The question is whether transvaginal roentgen therapy can achieve the same purposes with less disadvantages and whether or not it can improve upon the results of curie therapy of carcinoma of the cervix.

Following a course of external pelvic roentgen therapy lasting approximately six weeks, the author's patients receive a course of transvaginal irradiations without interval of rest. A single wide circular intravaginal field is used. This includes the cervix and fornices and permits irradiation of adjacent portions of the parametria. With the use of a single field, the dose that could be expected to be effective extends only partially into the parametria, but when transvaginal roentgen therapy has been preceded by external irradiation the area of combined effectiveness may extend as far as the pelvic wall.

All patients reported in this paper were treated with a 110 kilovolt unit at 25 centimeter target-cervix distance; at present the author is treating his patients with a 140 kv. unit and with 0.5 mm. copper filtration. In general, ten consecutive treatments of 400 roentgens, or a total of 4,000 roentgens in eleven days (measured in air at the level of the cervix) were given to the patients reported in this paper.

Conclusions. Transvaginal roentgen therapy is a valuable adjunct of external pelvic irradiation in the treatment of carcinoma of the cervix. It is the treatment of choice for carcinomas of the cervical stump. Lesser infectious and urinary complications, a low incidence of fistulas, and an apparent reduction in the proportion of local recurrences are the main advantages; in addition, this form of treatment does not require hospitalization. A three year symptom-free survival of 44 per cent has been obtained in a group of 76 patients who applied for treatment.—*Mary Frances Vastine, M.D.*

SAUER, HANS R., WATSON, ERNEST M., and BURKE, EUGENE M. Tumors of the testicle. *Surg., Gynec. & Obst.*, May, 1948, *86*, 591–603.

A review of 202 testicular tumors observed during a twenty-five year period is presented. In adopting the simplified classification of the Army Institute of Pathology (Friedman and Moore), the tumors were grouped as follows: seminoma (94), embryonal carcinoma (70), choriocarcinoma (3), teratocarcinoma (27), adult teratoma (5), and miscellaneous cell type tumors (3).

1. Metastases occurred in 117, or 57.9 per cent, of the cases. Their incidence was highest in patients with embryonal carcinoma (72.9 per cent) and lowest in those with seminoma (50 per cent). While metastases from seminomas remained quite often confined to the abdominoaortic nodes, it was the rule that embryonal carcinomas and teratocarcinomas metastasized also to the parenchymal organs.

2. Orchidectomy with regional lymph node dissection, followed by deep roentgen therapy, is advocated in the treatment of radioresistant testicular tumors and simple orchidectomy plus irradiation is preferred in the group of the more radiosensitive seminomas.

3. Indications, technique, and dosage of radiation therapy of testicular tumors are discussed. If metastases are present, favorable end results are obtained almost entirely in patients with seminoma or those with embryonal carcinoma plus seminoma. In contrast, response to roentgen irradiation is generally poor in patients with metastases from the other types of testicular neoplasms.

4. The end results obtained are presented: ninety-six (47.5 per cent) are alive and well,

2 are alive with disease, 95 died of the disease, 3 died of other causes and 6 were lost trace of. The five year cure rate was 48.9 per cent and the ten year cure rate was 34.7 per cent.

5. The following pattern of prognosis is presented. The prognosis is best in patients with adult teratoma or seminoma, particularly those that contain lymphoid stroma. It is less favorable in patients with teratocarcinoma or patients with embryonal carcinoma plus seminoma. The outlook is much more unfavorable in patients with tumors consisting of embryonal carcinoma with or without admixture of choriocarcinoma, and even worse in patients with plain choriocarcinoma.

6. In spite of certain shortcomings, the classification of Friedman and Moore is advocated as feasible because of its simplicity and because it is thought to promote a more common understanding among various investigators. However, in view of the difference in prognosis, it is suggested to divide embryonal carcinomas into tumors consisting of embryonal carcinoma plus seminoma and those of embryonal carcinoma in combination with other malignant cell structures.—*Mary Frances Vastine, M.D.*

BERMAN, LAWRENCE, and AXELROD, ARNOLD. Effect of urethane on malignant diseases; clinical, hematologic and histologic observations on patients with carcinoma, leukemia and related diseases. *Am. J. Clin. Path.*, Feb., 1948, *18*, 104–129.

Urethane therapy in 90 patients with various neoplastic diseases is reported. Favorable palliations in cases of carcinomatosis, lymphoblastoma and leukemia are noted. Urethane is most promising in androgen resistant carcinoma of the prostate and in chronic leukemia. Chronic myelogenous leukemia gives better results than chronic lymphatic leukemia. Decrease in size of enlarged lymph nodes, spleen and liver and reversion toward a more normal peripheral blood picture in leukemia was noted.

Nausea and vomiting in orally treated patients may be obviated by parenteral administration. Toxic effects include: hypoplastic anemia, leukopenia and thrombocytopenia. Possibility of hepatocellular damage needs further evaluation.

Undifferentiated leukocytes are affected more than differentiated forms. Erythroblastic tissue is more resistant than are either leukocytes or erythroblasts.

Hematologic improvement is not always accompanied by clinical improvement in chronic leukemia. Weight loss which is out of proportion to reduced caloric intake may represent important constitutional injury by urethane.

Repeated blood and bone marrow studies plus biopsy of tumors, lymph nodes, liver and spleen may aid in determining effects of treatment and mode of action of urethane.

Further investigation of urethane is warranted.—*Herbert Lobsenz, M.D.*

HERRMANN, JULIAN B., ADAIR, FRANK E., and WOODARD, HELEN Q. Effect of estrogenic hormone on advanced carcinoma of the female breast. *Arch. Surg.*, Jan., 1947, *54*, 1–9.

The authors report their experiences in treating 17 women with advanced carcinoma of the breast with estrogenic hormone. Ethinyl estradiol in doses varying from 0.15 to 0.7 mg. daily were used. Favorable responses were noted in approximately 40 per cent of the series. The favorable responses occurred predominantly in women over sixty years of age, whereas in younger women the estrogenic hormone seemed to accelerate the progress of the disease.

The patients who responded favorably showed evidence of improvement within the first four to six weeks of treatment. According to the authors, if no response was evident when this time had elapsed, there was little use in continuing the hormone.

Mild toxic reactions manifested by abdominal cramps and nausea were experienced by some early in the course of their hormone therapy. Vaginal smears studied in some patients revealed well developed estrus reaction. There were no changes in the serum calcium protein or alkaline phosphatase levels noted that could be ascribed to the daily administration of the ethinyl estradiol. A fall in the serum phosphorus level was observed in many patients, however.

The authors report in detail their experience in a patient forty years of age who was menstruating regularly to whom they gave the estrogenic hormone. The disease spread rapidly and suggested that it might have been the result of the specific action of the estrogen.—*Philip J. Hodes, M.D.*

MISCELLANEOUS

MARTIN, J. H. Radiation doses received by the skin of a patient during routine diagnostic

x-ray examinations. *Brit. J. Radiol.*, July, 1947, *20*, 279–283.

The skin dosage for various technical factors has been measured. A 70 kilovolt tube was used. At 20 milliamperes with the inherent filter and at 16 inch distance, the output is 175 roentgens per minute; at 30 inches it is 50 roentgens per minute. Adding 0.5 mm. of aluminum as a filter decreases the dose on the surface of a phantom 40 per cent with a concomitant drop of only 20 per cent on the surface of the film. With 1 mm. of aluminum added the skin surface dose drops 55 per cent while the film dose is reduced 30 per cent.

Data were collected from previous publications and from various hospitals in England as to the actual surface doses administered.

Chest: The long focal distance produces a low surface dose varying between 0.04 and 0.4 roentgen per exposure. The mean is 0.2 roentgen.

Intravenous pyelography: Doses range between 0.5 and 1.5 roentgen per exposure.

Skulls, sinuses: Four roentgens per exposure for the anteroposterior films and 1 to 2 roentgens for the laterals.

Gastrointestinal examinations: From 1 to 8 roentgens per film, with an average of 5 roentgens per film.

Spine: Ranges between 2 to 34 roentgens per film were found, with the average 5 roentgens.

Dental films: Because of the short distance the values vary from 1 to 15 roentgens per exposure with an average of 5. With the large number of films made there is usually overlapping, making this important.

Fluoroscopy: The average is between 50 and 100 roentgens for each five minute examination.—*E. F. Lang, M.D.*

Mitchell, J. S. Experiments on the mechanism of the biological action of fast neutrons using the summation method for lethal effects in mice. *Brit. J. Radiol.*, Sept., 1947, *20*, 368–380.

It has been previously demonstrated that although in general the biological effects of fast neutrons and gamma rays are similar, there are certain definite differences. In an attempt to determine whether the two types of radiation are completely additive and to determine the relative biological efficiency of the two, a series of experiments on mice was carried out. Lethal doses were used and various mixtures of gamma and fast neutron exposures were compared with doses which were similar in quantity but entirely of one type or the other. The particulars of the experiment are described in detail. Whole body irradiation was given.

The mixed doses are less effective than comparable doses of either fast neutrons or gamma radiation alone. This indicates a difference in the mechanism of action of these two radiations. An explanation is suggested. Since the relative efficiency of the two types of radiation varies with the duration of the treatment, it is thought that gamma rays act mainly on cells in the prophase of mitosis, and are thus relatively more effective if the treatment is prolonged. Fast neutrons, affecting the cells not only during mitosis but even during the resting stage, do not need a long exposure for significant effect.

A section is included on dosimetry of fast neutrons.—*E. F. Lang, M.D.*

Lewis, Margaret Reed. In vivo staining and retardation of tumors in mice by acridine compounds. *Am. J. M. Sc.*, March, 1948, *215*, 282–289.

Three hundred and thirty-one acridine compounds were administered orally to tumor-bearing mice in known per cent of dry weight of their food. Two hundred and four stained tumor tissue and the majority of those that colored tumors also somewhat retarded their growth. The administration of acridine compounds did not prevent tumor growth or bring about regression of growing tumors. It simply slowed the rate of multiplication of tumor cells.

The majority of the 9 amino acridines that stain tumor tissue as well as retard its growth show dialkyl-amino-alkyl-amino chains in the nine positions.—*Herbert Lobsenz, M.D.*

Lasnitzki, Ilse. A quantitative analysis of the direct and indirect action of x radiation on malignant cells. *Brit. J. Radiol.*, June, 1947, *20*, 240–247.

Mouse adenocarcinoma 63 is a transplantable small cell carcinoma. A number of mice were inoculated with this tumor and the growths were examined microscopically at various intervals after irradiation. Tissue cultures of the same tumors were irradiated with similar doses and examined at similar intervals.

The effects common to both tumors and cultures were previously reported and are: absent and irregular mitosis, increase in cell size, and the appearance of degenerative cells. Vascular

reaction of a severe nature was demonstrated in the tumors with the sublethal dose which was used.

An analysis of the present data revealed that changes occurring during the first day are the result of direct action on the malignant cells. These changes are the appearance of degenerative cells and absence of mitosis. After the second day the number of mitoses in the tumor rapidly builds up but there is much slower return of mitosis in the culture. The actual level of mitosis in the tumor is low, however, and no further increase occurs; in the culture return of mitosis is quite slow but it returns to a normal level. Many more degenerative cells appear in the six days after the first in the tumor but not in the culture. Mitosis in the tumor is only 39 per cent of that in the culture, while degeneration in the culture is only 35 per cent of that in the tumor.

Thus, although in the two types of malignant cells the results of irradiation are qualitatively similar, they vary in quantity and in time of appearance. In the tumor early mitotic recovery and development of degenerative cells is dependent upon the intact blood supply, but after the second day the irradiation-induced vascular damage produces failure of total mitotic recovery and increase in degenerative cells. About one-third of the total effect is due to the direct action and two-thirds to the indirect action of the irradiation.—*E. F. Lang, M.D.*

WOLFF, BRIGITTE, and ELLIS, FRANK. Quantitative histological analysis of radiation effects in human carcinomata. *Brit. J. Radiol.*, Sept., 1947, *20*, 381–386.

Biopsies of tumors made before, during and after roentgen treatment can be used to determine the response to irradiation. Cells are counted in selected areas and classified into four categories: resting, dividing, differentiating and degenerative cells. The change in the ratio of the cells in these groups indicates the response of the tumor to treatment.

A series of 37 tumors was examined by biopsies taken immediately before treatment and then after seven, fourteen, and, in most cases, twenty-one days. The response as determined from the biopsies was compared with the response as estimated clinically. It was found that in some cases of poor histological response with good initial clinical response, later observation showed that the clinical course was retrogressive after some interval. In other words, the longer the period of observation, the more agreement there was between the clinical and histological findings.

In this series of 37 cases there was agreement in 92 per cent of those observed for fifteen months or more. In the 6 cases where there is disagreement, each tumor was at a site where slow-growing cancers usually arise.

This method of examination is suggested not only as a means of establishing prognosis after roentgen therapy, but also as a method of determining rapidly which treated tumors will not respond so that they may be attacked surgically before too late.—*E. F. Lang, M.D.*

HOWARTH, FRANK. Isotopes and radiation hazards. *Lancet*, July 10, 1948, *2*, 51–53.

This paper is intended as a warning to those British physicians who are now beginning to have radioactive isotopes available for experimental use. It contains a fairly good review of the literature on this subject.—*J. S. Summers, M.D.*

MOORE, FRANCIS D. The use of isotopes in surgical research. *Surg., Gynec. & Obst.*, Feb., 1948, *86*, 129–147.

Although the types of biological research which may be carried out with radioactive isotopes are many, they tend to arrange themselves into several significant subheadings.

1. *Permeability and Membrane Transfer.* In the study of the penetration of ions or molecules from one area of the body fluids to another, isotopes make their greatest fundamental contribution to research. Whether the interposing membrane be the capillary, the lymphatic, the cell, the nucleus or some special barrier such as the glomerulus or choroid plexus, and whether the tracer be an ion or a large protein molecule, isotopic techniques inform the investigator of the relationships between the two sides of the membrane in a fashion which cannot be gained in any other way.

2. *Tracing Metabolic Pathways.* Though we can dissect a whole animal and analyze its constituent organs chemically for an element, we have no way of knowing the previous position of the element as found in the various organs, nor its distance in point of time or metabolic pathway from its source, such as the gastrointestinal tract. By the use of a tagged element it is possible to give one radioactive dose to the organism and at varying periods after administration to analyze the animal and find

the position in the various organs and body fluids of this single dose. When one has analyzed the whole organism some hours after a feeding containing a radioactive element, the distribution which one finds is presumably typical for the distribution of any similar amount of stable element administered the organism.

3. *Utilization by Specific Organs.* As a refinement of the above investigation, it is possible by means of isotopes to study the utilization of elements or compounds by specific organs. An outstanding example of this is the utilization by the thyroid of iodine.

The autoradiograph presents the most intimate picture of utilization of elements or compounds by specific tissues, and belongs in this category of observation. The autoradiograph is a record made on photographic emulsion by the beta radiation of isotopes previously administered to the animal or patient; by comparison with microscopic slides and suitable magnification, exact histochemical localization of isotopes may be obtained.

4. *External Localization.* The concept of injecting a radioactive substance into an animal or a patient, and then casting about over the living organism with a Geiger counter to find out where the element went, has gripped the imagination of investigators for many years. In the case of the thyroid the selective localization of the radioiodine in thyroid tissue, whereever that tissue is, has provided again, by coincidence, a ready application of such methods. Studies of the circulation by externally placed counters, using Na, have also been carried out. Here, however, the lack of selective localization makes interpretation much more difficult.

5. *"Tagging" of Complex Compounds.* Attempts to label complex organic compounds with radioactive isotopes go back to the earliest days of the cyclotron. Many important molecules which contain such elements as carbon, phosphorus, iodine, iron, or sulfur and which were susceptible of synthesis, could by synthethesized with the radioelement in place of its stable isotope.

6. *Fluid Space Measurement.* The measurement of volumes of body fluid available for the solution of an ion may be carried out by dissolving a tracer for that ion in the body fluid space in question, allowing mixing to occur, making appropriate corrections for excretion and then studying the final dilution obtained.

7. *Therapy with Radioactive Isotopes.* This is an application of radioactive isotopes dependent upon selective localization in pathologic tissues.—*Mary Frances Vastine, M.D.*

Elkin, Daniel C., Cooper, F. W., Rorher, R. H., Miller, W. B., Shea, Patrick, and Dennis, E. W. The study of peripheral vascular disease with radioactive isotopes. Part I. *Surg., Gynec.& Obst.*, July, 1948, *87*, 1–8.

Radioactive sodium carbonate is received from the pile at Oak Ridge, Tennessee. The mass obtained weighs 0.3 gram and is rated 35–110 milliroentgens of gamma radiation per hour at 24 inches from source of gamma radiation. This material is converted into sodium chloride by the addition of hydrochloric acid. Neutralization is effected by titration with sodium hydroxide. The resulting sodium chloride solution is evaporated to dryness and is redissolved in pyrogen-free distilled water, and sterilized by autoclave. Dilutions of the material are made depending upon the proposed method of utilization.

Two methods of study were employed.

1. The first method described by Smith and Quimby involves the "build-up" of radioactive sodium in the tissues of the extremities following its intravenous injection in the arm.

2. The other method was suggested by Kety. It is a relative flow determination based on the rate of disappearance of radioactive sodium when injected intramuscularly.

The latter method has been utilized in 115 individuals both normal and with vascular disease. It has been used in normal individuals to evaluate the effect of certain drugs and other measures reputedly effective in enhancing the circulation in the extremities. Similarly it has been used in the evaluation of patients with vascular disease and their response to therapy. These observations are to be reported at a later date.—*Mary Frances Vastine, M.D.*

Sievert, Rolf M. The tolerance dose and the prevention of injuries caused by ionizing radiations. Silvanus Thompson Memorial Lecture. *Brit. J. Radiol.*, August, 1947, *20*, 306–318.

The important physiological effects of ionizing radiations are in the skin, the blood and blood forming organs, and the gonads and germ cells. A minimal erythema is produced by 200 to 600 roentgens given in one dose, and an exposure ten times as great produces skin necrosis. Protraction and fractionation both decrease the effect on the skin.

Determination of the extent of injury to the blood cells is more difficult to assess. A preliminary study has shown that hypersegmentation, pathological lymphocytes, granulocytopenia, and a shift to the left are the most marked changes to be demonstrated in the peripheral blood. Effect on the gonads is also difficult to determine. Sterility occurs long after blood changes develop. Genetic changes can be determined only with long, exact statistical studies.

The term tolerance dose may be used to describe either that dose which produces barely perceptible biologic effect (active tolerance dose) or the maximum allowable dose for radiological workers (safety tolerance dose). The active tolerance dose cannot be determined at present because of the variation in standards, the difficulty in obtaining standard conditions, and the necessity of experimentation on man. As the safety tolerance dose should be determined on the basis of this, its determination also is at present a matter of opinion. The limits of the tolerance dose may be based on the effect on the skin, when the longer wavelengths are considered, or on the effect on the body as a whole with the shorter wavelengths, in which case the action on the blood is used.

The skin tolerance dose may be estimated by adjustment of the figure arrived at by extrapolation of a fractionation curve to a very small daily dose. The safety tolerance dose thus arrived at is between 0.1 and 0.5 roentgen per day. This is in agreement with figures obtained by other methods. Determination of the blood tolerance dose is more difficult. By grouping roentgen-ray workers into four groups, according to the risk involved in their daily work, and examining their blood, it was found that daily doses of from 0.02 to 0.05 roentgen can give rise to blood changes.

The effects of small doses on animals and plants have been determined, but these unfortunately are not directly applicable to man. Intensities as low as 0.001 to 0.005 roentgens which is in the range of the normal ionization existing in nature, have been shown to produce changes is growth rate and in timing of life cycle.

Irradiation can be measured for these tests photographically, with a fluorescent screen, with ionization chambers, or with Geiger-Müller counters. In many cases, however, particularly in diagnostic work, it is only when actual leaks in protection are discovered that the measurements are meaningful. With a negative reading, one cannot be certain that the involved personnel are acting normally, or that all the leaking radiation is being measured. The best control method is rigid inspection, control of working technique, and regular blood counts.

In Sweden, control of radiological work has been established by law and regular inspections are carried out. The most dangerous conditions are those in a small roentgen department without a radiologist where risk is neglected, in large establishments where protection is sacrificed for efficiency, and where much work is done on insane individuals or children. The risk of dental equipment, because of the unprotected primary beam, has been underestimated.—*E. F. Lang. M.D.*

Reproduced from a radiograph made on
KODAK BLUE BRAND MEDICAL X-RAY FILM

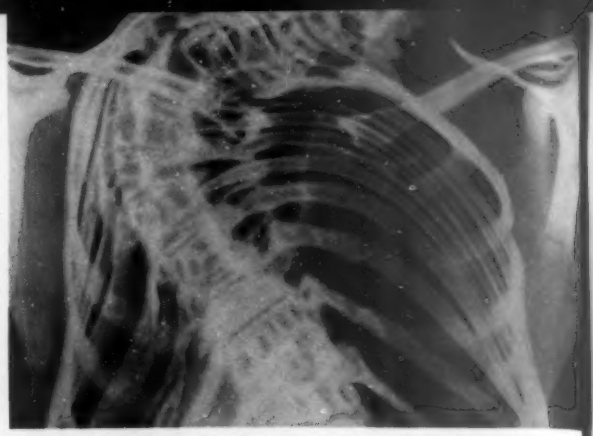
Kodak

Maximum radiographic

Sharpness...

with this

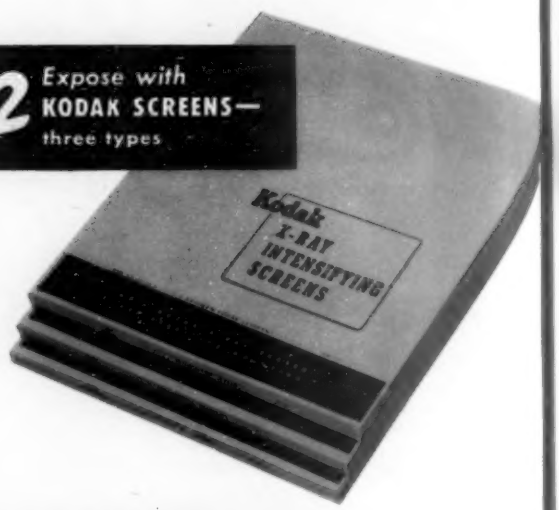
RADIOGRAPHIC RULE of THREE



Drawing of the radiograph reproduced on other si

1 Use **KODAK FILM— BLUE BRAND**

2 Expose with **KODAK SCREENS—** three types



3 Process with **KODAK CHEMICALS—** liquid or powder

SHARPNESS is at its best... when you use x-ray products made by Kodak to work together. Then... well-defined radiographic images are produced by the screens... made latent on the film ... made lasting in full detail by the processing chemicals.

KODAK PRODUCTS FOR RADIOGRAPHY

Blue Brand and No-Screen Medical X-ray Films ... Photoflure Films for photoradiography ... Periapical and Occlusal Dental X-ray Films ... Fine-Grain, High-Definition, and Ultra-Speed X-ray Intensifying Screens ... Exposure Holders ... Safelight Lamps and Filters ... Identification Printer ... Processing Hangers ... Liquid and Powder X-ray Developers, Fixers, and Replenishers ... Electric Chemical Mixers ... Thermometers ... Film Corner Cutter ... Illuminator.

EASTMAN KODAK COMPANY

Medical Division, Rochester 4, N. Y.

"Kodak" is a trade-mark

Kodak

Standardize on STANDARD ACCESSORIES

write for our complete catalog specifications and prices

Everything from A to Z

Accessories and Supplies
Aprons and Gloves
Barium Meal
Bucky Diaphragms, Fittings
Cabinets
Cassettes
Cassette Holders
Diagnostic Opaques
Darkroom Accessories
Dryers
Films, X-ray
Fluoroscopes
Illuminators
Lamps
Measuring Instruments
Meters
Protection Equipment
Screens
Stabilizers
Stereoscopes
Tanks
Timers
Valve Tubes
X-ray Tubes

Standard's complete line of quality accessories and equipment fulfills every x-ray requirement. Only a few of the many different types of apparatus and constantly needed items are listed and shown here. Craftsmanship and dependability—the result of more than 30 years of service to the profession—and our nationally known policy of the lowest prices consistent with fine workmanship make it worth your while to Standardize on Standard equipment. Your orders and inquiries will be given prompt, understanding attention.

PIONEERS IN X-RAY EQUIPMENT for OVER 30 YEARS

Standard X-RAY COMPANY

1932 NORTH BURLING ST. CHICAGO 14, ILLINOIS

IN
SPOT FILM
RADIOGRAPHY—

L-7 Stationary Filter Grids

ARE
PREFERRED—

a—FOR SHORT EXPOSURES

The very low density interspace material between lead strips readily passes the primary beam.

b—FOR ABSENCE OF "CUT-OFF"

—because they can be obtained with focused lead strips. (Parallel lead strips are acceptable up to 8-inch width, but focused lead strips are required for all larger sizes.)

L-F

★ WRITE for detailed information

Address:

THE LIEBEL-FLARSHEIM CO.
CINCINNATI 2, OHIO

Free Yourself from "DARKROOM DRUDGERY"

Modern X-Ray developing techniques have eliminated laborious practices including the measuring and mixing of powders, the heating and cooling of water. Today, you're hours ahead with Urell Concentrated X-Ray Solutions. Simply add water and use instantly: "*Dilute* and *Develop.*" Urell has been specified for years by technicians everywhere and is produced by America's oldest exclusive manufacturers of X-Ray solutions. The first step toward eliminating darkroom drudgery *with safety* is to order Urell solutions today from your dealer.

URELL CONCENTRATED LIQUID DEVELOPER	URELL CONCENTRATED LIQUID FIXER
1 Qt. Concentrate $1.00 (Makes one gallon)	1 Qt. Concentrate $1.00 (Makes one gallon)
4 Qts. Concentrate 3.35 (Makes four gallons)	4 Qts. Concentrate 3.35 (Makes four gallons)

DILUTE AND DEVELOPER DEVELOP!

Urell Inc.

2630 HUMBOLDT STREET, LOS ANGELES 31, CALIFORNIA

For FLEXIBILITY
COMFORT AND
SAFETY
USE

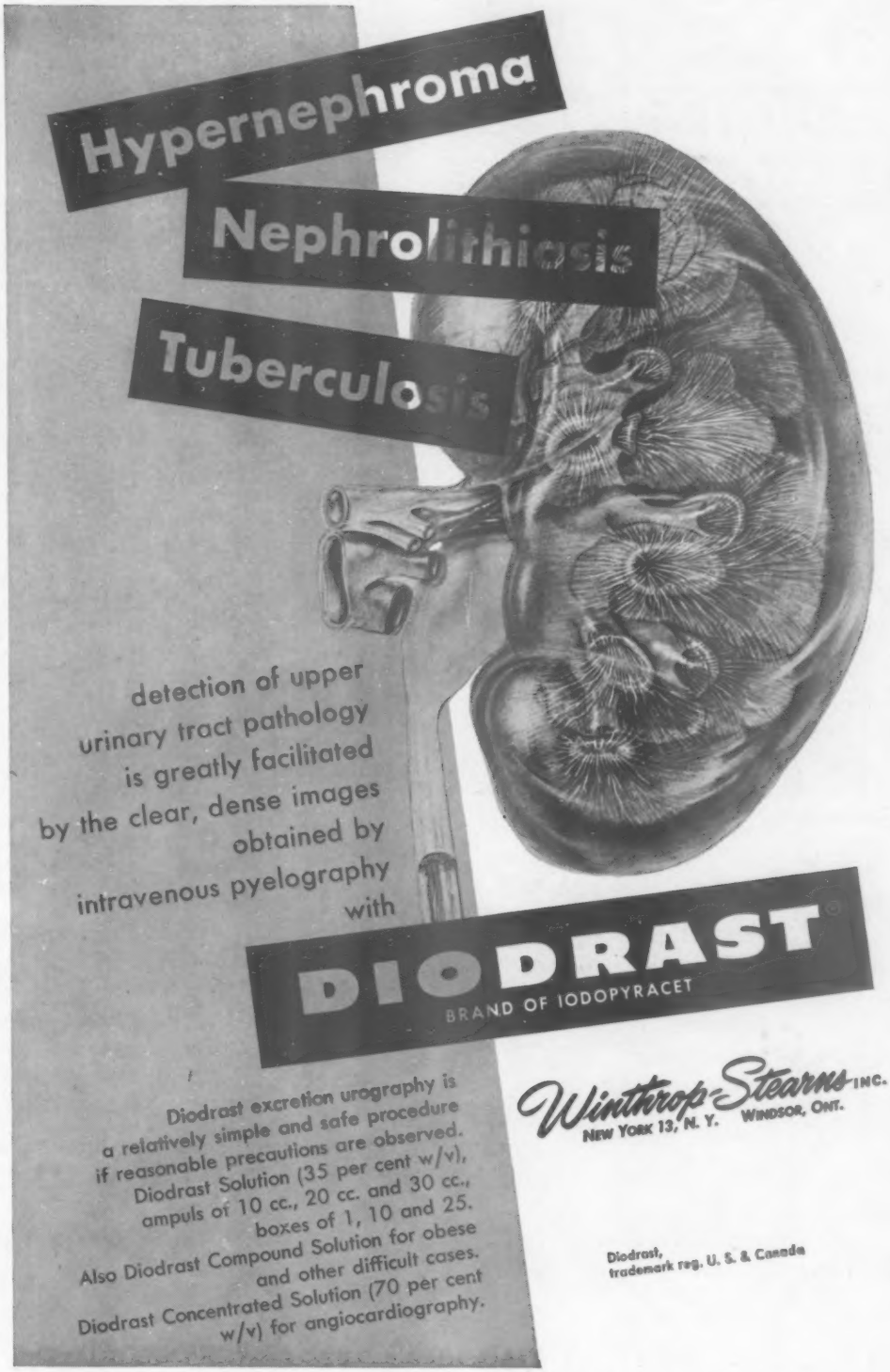
ALL-LEATHER
X-RAY GLOVES

AVAILABLE IN
THREE
GRADES OF
OPACITY AND
SEVERAL
SIZES.

CONSULT YOUR DEALER

Manufactured Solely By

LIBERTY DRESSING CO., INC.
GLOVERSVILLE, NEW YORK


Hypernephroma
Nephrolithiasis
Tuberculosis
detection of upper urinary tract pathology is greatly facilitated by the clear, dense images obtained by intravenous pyelography with
DIODRAST®
BRAND OF IODOPYRACET
Diodrast excretion urography is a relatively simple and safe procedure if reasonable precautions are observed.
Diodrast Solution (35 per cent w/v), ampuls of 10 cc., 20 cc. and 30 cc., boxes of 1, 10 and 25.
Also Diodrast Compound Solution for obese and other difficult cases.
Diodrast Concentrated Solution (70 per cent w/v) for angiocardiography.
Winthrop-Stearns INC.
NEW YORK 13, N. Y. WINDSOR, ONT.
Diodrast, trademark reg. U. S. & Canada

DESIGNED...
for superficial therapy...

Easily applied to all parts of the body.

The Maximar 100 was designed expressly for superficial therapy. The new Coolidge tube, with its beryllium window, is so mounted that radiation passes only through the tube window and the intervening air.

Because the beryllium window has an inherent filtration of approximately 0.1 mm aluminum, it makes available radiation of extremely soft quality. This soft radiation is absorbed in the superficial layers of tissue with a consequent reduction in the dose received by deeper tissues.

Another result of this low inherent filtration is high output. At 100 kvp and 5 ma, output is up to 900 roentgens per minute at a focal-skin distance of 30 centimeters. At 30 cm focal-skin distance, a 20 cm circle is covered. The intensity within 2 cm of the field edge is about 80 per cent of that delivered at the field center.

Add to these advantages the mechanical flexibility and electrical simplicity of the Maximar 100, and you will see why more physicians look to the G-E symbol when they invest in x-ray equipment.

FREE If you'd like to know more about the Maximar 100, write for our fact-filled booklet. General Electric X-Ray Corporation, Dept. B-21, 4855 W. McGeoch Ave., Milwaukee 14, Wisc.

the Maximar 100

GENERAL ELECTRIC X-RAY CORPORATION

• General Electric X-Ray Corporation manufactures and distributes x-ray apparatus for medical, dental, and industrial use; electromedical apparatus; x-ray and electromedical supplies and accessories.

In answering advertisements please mention THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

GIVING A MOST EFFECTIVE MASS ATTACK

Myers and McKinlay: THE CHEST AND THE HEART

By* J. Arthur Myers, M.D., Ph.D., F.A.C.P., *Professor of Medicine, University of Minnesota Medical School; and* C. A. McKinlay, M.D., *Clinical Associate Professor of Medicine, University of Minnesota Medical School. Prepared by 61 contributing specialists, the 87 chapters will greatly enlarge the ability of the roentgenologist in diagnostic examinations. The chapters on development and anatomy, innervation of the chest and on respiration are of special use. ***Published in 1948; two volumes; 1856 pages; 769 figures; 1003 illustrations and occasional color plates*** **$25.50**

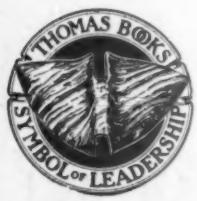
Orley: NEURORADIOLOGY

By* Alexander Orley, M.D., F.F.R., D.M.R.&E., *Hon. Consulting Radiologist, West End Hospital for Nervous Diseases, London. An up-to-date manual of neuroradiological technics and diagnosis based on the author's own experiences. Dr. Orley presents thorough explanations of radiographic examinations including the skull, temporal bone, deformities and injuries. The 572 illustrations add special value to this comprehensive and well organized work of real value to the roentgenologist. ***Published in 1949; 436 pages; 572 illustrations*** **$11.50**

Di Rienzo: RADIOLOGIC EXPLORATION OF THE BRONCHUS

By* S. Di Rienzo, M.D., *Assistant Professor of Radiology, University of Cordoba, Argentina.* Translation by Thomas A. Hughes.** Based on wide clinical experience, it is a comprehensive treatise on bronchography. Much is devoted to fluoroscopic and photographic procedures and with the use of bronchography in chronic diseases. A guide to roentgenologists who wish to improve their interpretation of bronchographic studies. ***Published in 1949. 450 pages; 466 figures **$8.50**

Sent on ten days approval inspection without cost or obligation, you may remit within thirty days for those books kept. May we send you these books for your inspection?



CHARLES C THOMAS • PUBLISHER • SPRINGFIELD • ILLINOIS

new ease, surety and safety in female sterility procedures

automatically performs all three recognized sterility tests

tubul insufflation (Rubin test)

hysterosalpingography (Jarcho-Béclère method)

combined pneumoperitoneum with pelvic viscerography

Picker announces the improved Weisman

GYNOGRAPH

The *improved* Weisman Gynograph offers a new degree of ease, convenience, and surety in making tubal sterility tests. At no sacrifice of compactness (the complete instrument fits easily between the thighs), it incorporates a positive Flow-Meter *calibrated directly in cc per minute* . . . the physician knows exactly *how fast* and *how much* gas is entering the patient. By means of a new Pressure Valve and Control, he can preset gas pressure from 100 to 250 mm. The preset pressure will then be maintained intrauterinely during the entire test, or it can be varied as little as a millimeter at a time, at will. A sudden rise in gas output will be automatically relieved . . . *there is no danger of pressure rising above the preset point.* So simple and automatic is the Gynograph technic that the doctor can perform it alone with ease, certainty, and absolute safety. The coupon here will bring a bulletin describing the instrument and its clinical technic.

PICKER X-RAY CORPORATION
300 Fourth Avenue—New York 10, N. Y.

☐ Please have your representative call.
☐ Please send descriptive bulletin on Gynograph.

NAME.....

ADDRESS.....

CITY.....STATE.....

The Improved VIDEX Cone

now is being produced by

WRENCO, INC.

which succeeds the Wright Engineering Co. as manufacturers of this device

The new company is accumulating a stockpile of the VIDEX Cones to insure prompt delivery to our customers.

Thus the convenience, speed, accuracy and top radiographic quality of the Improved VIDEX Cone now becomes available in volume.

The VIDEX may be purchased through branches of General Electric X-Ray Corp., Picker X-Ray Corp., Westinghouse Electric Corp., and Kelley-Koett Mfg. Co., or from your regular dealer.

For further information write to

WRENCO, INC., MOUNTAIN LAKES, N. J.

---

chest x-ray patients on admission–

Without Equipment Investment!

Make this step forward by adding the Powers Magazine Cassette to your present equipment.

X-Ray Paper for the Magazine Cassette comes in convenient rolls—perforated so that radiographs are individually processed with standard equipment and chemicals. One roll makes 50 full-size radiographs.

POWERS X-RAY PRODUCTS Reg. U.S. Pat. Off.

You can avail yourself of this equipment without investment. Write for compiete information and literature.

POWERS X-RAY PRODUCTS, INC.

Group Radiography GLEN COVE, LONG ISLAND, N. Y.

Roentgen Interpretation

By GEORGE W. HOLMES, M.D.

Board of Consultation, the Massachusetts General Hospital and Clinical Professor of Roentgenology Emeritus, Harvard Medical School

AND

LAURENCE L. ROBBINS, M.D.

Radiologist-in-chief to the Massachusetts General Hospital and Associate in Radiology, Harvard Medical School

Colles' fracture—lateral view. The shadow of the ulna overlaps that of the radius, and conceals the deformity in the radius.

MANY new methods of diagnosis and treatment in which the roentgen-ray plays its part have been introduced since the publication of the sixth edition of this work. In order that the book may reflect accurately the present status of roentgen diagnosis, many changes of importance have been incorporated in this edition. The subject matter has been thoroughly revised and brought up to date and references to current medical literature have been selected to give additional information.

The outstanding characteristics of this text are its clearness and conciseness. It covers the entire body, part by part, and indicates how many processes may be revealed by the roentgen-ray. It points out the pitfalls in diagnosis and it illustrates the various lesions and deformities. Here will be found the essentials of correct interpretation. The work should be of value to all physicians interested in the interpretation of roentgen-ray films. The illustrations are well chosen and are produced with unusual clarity, owing to the high quality of paper used throughout. Many of the illustrations formerly reproduced from positive prints made from the original negatives have been discarded for negative illustrations, now the generally accepted method. This work will continue to serve as an excellent text for students and practitioners who wish a concise ready reference covering the fundamentals of roentgen diagnosis.

Seventh edition. 398 pages, 266 illustrations. $7.00.

Washington Square **LEA & FEBIGER** Philadelphia 6, Pa.

Advertisers in

The
AMERICAN JOURNAL
OF ROENTGENOLOGY
AND RADIUM THERAPY

are worthy of your patronage

Advertising in THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY marks a firm as outstanding, because of the exacting standards it must maintain in order to use space in the pages of the Journal.

The products advertised, the claims made for them, and the ethical reputation of the firm itself are carefully reviewed by the editors before advertising is accepted.

An advertisement in the Journal is significant of the approval of both the editors and the publishers. You may patronize these advertisers with confidence.

OFFICIAL ORGAN
THE AMERICAN ROENTGEN RAY SOCIETY
THE AMERICAN RADIUM SOCIETY

FROM ANSCO'S X-RAY LAB THIS MONTH . . .

Here's the NEW High-Speed Film you asked for

and the effect it will have on your work!

In actual demonstration and use, the new Ansco High-Speed Film shows improved gradation, making your radiographs a great deal easier to read.

You'll notice the effect of this improved gradation in many ways: for example in the contrast between the transverse processes and the surrounding tissue in an AP radiograph of a spine.

You'll also find that the latitude of this film makes it easier to read detail in critical areas, such as under the heart shadow, and at the peripheries of the lung field.

The film's lighter base color gives you a cleaner, clearer film, easier to interpret.

Means no change in technique

But new as this film is, it requires no changes in your exposing and processing techniques.

Ansco's new High-Speed Film will perform excellently under your normal processing conditions.

It produces highly diagnostic radiographs with all techniques, including the new 125 kv range.

And all of these advances have been made without sacrificing speed in any way. Ansco High-Speed Film is one of the fastest films on the market today.

Radiologists helped develop it

It is no mere chance that this new High-Speed Film is so unusual.

For Ansco's x-ray technicians visited a large number of radiologists before they started work on this film back in 1946.

They asked those radiologists to evaluate several types of film, and to indicate the properties they would like to have in an ideal x-ray film.

The new Ansco High-Speed Film is the film they asked for—the result of three years of research and development.

An Ansco representative will gladly supply you with further data and test film. Ask him. You'll be amazed at the many ways the new Ansco High-Speed Film can ease your radiographic work. **Ansco, Binghamton, N. Y.** A Division of General Aniline & Film Corporation. "From Research to Reality."

ASK FOR

Ansco

HIGH-SPEED X-RAY FILM

YOU CAN ACQUIRE VALUABLE BACK VOLUMES AND SINGLE ISSUES OF THE PUBLICATIONS OF

The American Roentgen Ray Society

A limited quantity of the issues available are listed below. Orders are subject to the exhaustion of available stock. This offer is subject to withdrawal without notice. **NOTE: For your convenience, the same price—$1.50 per copy—applies to all issues—no quantity discount. (Effective February 1, 1949)**

Order BACK ISSUES of the Journal from:

CHARLES C THOMAS • PUBLISHER 301-327 East Lawrence Avenue SPRINGFIELD • ILLINOIS

American Quarterly of Roentgenology: 1906-1913

Vol. 2, No. 1, Dec. 1909
Vol. 2, No. 2, March 1910
Vol. 3, No. 1, 2, April, July 1911
Vol. 3, No. 3, Dec. 1911
Vol. 3, No. 4, March 1912
Vol. 4, No. 1, Aug. 1912
Vol. 4, No. 3, Feb. 1913
Vol. 5, No. 1, Sept. 1913

The American Journal of Roentgenology: 1914-1922

Vol. 2, Nos. 11 and 12, Dec. 1915
Vol. 3, Nos. 3, 5, 6, 7, 8, 9, 10 (1916)
Vol. 4, Nos. 1, 5, 6, 9, 11,12 (1917)
Vol. 5, Nos. 2, 3, 4, 6, 7, 8, 9, 11, 12 (1918)
Vol. 6, Nos. 1, 2, 3, 4, 5, 6, 7, 8, 10, 12 (1919)
*Vol. 7, Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12 (1920)
Vol. 8, Nos. 8, 9, 10, 11, 12 (1921)
Vol. 9, Nos. 1-12 inclusive (1922)

The American Journal of Roentgenology and Radium Therapy: 1923-1929

Vol. 10, Nos. 5, 6, 7, 8, 9, 10, 11, 12 (1923)
Vol. 11, Nos. 1-6 Inclusive (Jan.-June 1924)
Vol. 12, Nos. 1-6 (Inclusive (July-Dec. 1924)
*Vol. 13, Nos. 1-6 Inclusive (Jan.-June 1925)
Vol. 14, Nos. 1-6 Inclusive (July-Dec. 1925)
Vol. 15, Nos. 1-6 Inclusive (Jan.-June 1926)
Vol. 16, Nos. 1-6 Inclusive (July-Dec. 1926)
Vol. 17, Nos. 1, 2, 3, 5, 6 (First half of 1927)
*Vol. 18, Nos. 1-6 Inclusive (July-Dec. 1927)
*Vol. 19, Nos. 1-6 Inclusive (Jan.-June 1928)
Vol. 20, Nos. 2, 3, 4, 5, 6 (Last half of 1928)
Vol. 21, Nos. 1, 3, 4, 5 6 (First half of 1929)
Vol. 22, Nos. 1-6 Inclusive (July-Dec. 1929)

The American Journal of Roentgenology and Radium Therapy: 1930-1947

Vol. 23, Nos. 1-6 Inclusive (Jan.-June 1930)
Vol. 24, Nos. 1-6 Inclusive (July-Dec. 1930)
Vol. 25, Nos. 1-6 Inclusive (Jan.-June 1931)
Vol. 26, Nos. 1-6 Inclusive (July-Dec. 1931)
Vol. 27, Nos. 1-6 Inclusive (Jan.-June 1932)
Vol. 28, Nos. 1-6 Inclusive (July-Dec. 1932)
Vol. 29, Nos. 1-6 Inclusive (Jan.-June 1933)
Vol. 30, Nos. 1-6 Inclusive (July-Dec. 1933)
Vol. 31, Nos. 1-6 Inclusive (Jan.-June 1934)
Vol. 32, Nos. 1-6 Inclusive (July-Dec. 1934)
Vol. 33, Nos. 1-6 Inclusive (Jan.-June 1935)
Vol. 34, Nos. 1-6 Inclusive (July-Dec. 1935)
Vol. 35, Nos. 1-6 Inclusive (Jan.-June 1936)
Vol. 36, Nos. 1-6 Inclusive (July-Dec. 1936)
Vol. 37, Nos. 1-6 Inclusive (Jan.-June 1937)
Vol. 38, Nos. 1, 2, 3, 6 (Last half of 1937)
Vol. 39, Nos. 1-6 Inclusive (Jan.-June 1938)
Vol. 40, Nos. 1-6 Inclusive (July-Dec. 1938)
*Vol. 41, Nos. 1-6 Inclusive (Jan.-June 1939)
Vol. 42, Nos. 2, 3, 4, 5, 6 (July-Dec. 1939)
*Vol. 43, Nos. 1-6 Inclusive (Jan.-June 1940)
Vol. 44, Nos. 1-6 Inclusive (July-Dec. 1940)
Vol. 45 (Dec. 1941)
Vol. 46, Nos. 2, 4, 6 (Last half of 1941)
Vol. 47, Nos. 1-6 Inclusive (Jan.-June 1942)
Vol. 48, Nos. 1-6 Inclusive (July-Dec. 1942)
*Vol. 49, Nos. 1-6 Inclusive (Jan.-June 1943)
Vol. 50, Nos. 2 (Last half of 1943)
Vol. 51, Nos. 3, 4, 5, 6 (First half of 1944)
Vol. 52, Nos. 2, 4 (Last half of 1944)
Vol. 53, Nos. 2, 3, 4, 6 (First half of 1945)
Vol. 54, Nos. 1-6 Inclusive (July-Dec. 1945)
Vol. 55, Nos. 3, 5, 6 (First half of 1946)
Vol. 56, Nos. 1-6 Inclusive (July-Dec. 1946)
Vol. 57, Nos. 3, 4, 5, 6 (First half of 1947)
Vol. 58, Nos. 1-6 Inclusive (July-Dec. 1947)
Vol. 59, Nos. 1-6 (First half of 1948)
Vol. 60, Nos. 1-6 (Last half of 1948)

*** These scarce issues will not be sold unless the entire volume is purchased:**

Vol. 7, Nos. 10, 11, Oct., Nov. 1920
Vol. 13, Nos. 4, April 1925
Vol. 18, Nos. 1, 2, July, Aug. 1927
Vol. 19, Nos. 2, 5, Feb., May 1928
Vol. 41, No. 1, Jan. 1939
Vol. 43, No. 1, Jan. 1940
Vol. 49, No. 1, Jan. 1943
Vol. 53, Nos. 1, 2, 5, 6, Jan., Feb., May, June 1945